FLIGHT
and
The AIRCRAFT ENGINEER

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The Outlook

Parachute Troops

AN article in the foregoing issue of *Flight* gave some account of how the Army and the R.A.F. work together in training parachute troops. So far, in this war, the British Army has only once used air-borne troops—namely, for a landing in South Italy, about the results of which no official announcements have been made. Both the Germans and the Russians have used them a good deal. They obviously resemble the old cavalry in being "an arm of opportunity," very effective when used at the right moment and in the right circumstances, but not to be employed everywhere or in every engagement. The men who volunteer for this work know that it is hazardous, not because they have to drop out of aircraft, but because of what may happen after they have landed; and therefore the men must be full of the spirit of initiative and must be trained to the highest pitch of efficiency. Success depends very largely on the accuracy with which the R.A.F. crews take the troops to the right spot at precisely the right time. The two Services are working together in the utmost harmony.

It has been suggested that parachute troops may prove to be the best form of international police after peace has been restored to this suffering world. Then perhaps the greatest problem will be to prevent any nation with an aggressive spirit from arming in defiance of treaty obligations. If such a thing were suspected, the arrival by air of a battalion or so of parachute troops would be the most effectual means of ascertaining what was happening and putting a stop to it. The suggestion most commonly made for dealing with such a situation is a bomber force; but it seems to us that parachute troops would be preferable. For one thing, they would be able to see what was happening and they would know what they were doing to stop it. There would be no chance of a bomb missing the target and doing unnecessary damage.

Parachute troops might also be a very good substitute for "police bombing" on the frontiers of the Empire, such as the Aden Hinterland and the North-West Frontier of India.

A Lesson

LORD GORT'S despatches now are rather ancient history, but owing to pressure on our space we have not been able to comment on them before, and they ought not to pass without notice in these columns. For readers of *Flight* the important point is the misgivings which the C.-in-C. felt about the air support provided for his army. "I felt," he wrote, "that the resources of the Air Component would prove insufficient for the requirements of the Force during operations." Of course, it was not his business to remark on the Advanced Air Striking Force, which at first was under the Bomber Command in England and not under the C. in-C. But certainly Lord Gort's misgivings proved well founded, and after three days of hard fighting the number of Hurricanes and Gladiators in the Air Component was reduced to some 50 machines.

Everybody recognises the wisdom of refusing to emasculate the defensive powers of the Fighter Command, though when the Germans advanced it was found possible to send a few more fighter squadrons out from England. The mistake lay in the past, in not having budgeted separately for so many fighter squadrons for Fighter Command and so many more for Army work.

The lack of foresight of the Air Ministry in dealing with the Army had tragic consequences, but there is reason to expect that the tragedy will not be repeated.

The Freedom of the Air

"LET us win the war first" is a very handy phrase. It can be used to express the very natural feeling that we are much too preoccupied at present to worry about anything else. That is as it should be. But it can also be made an excuse for putting off some unpleasant task which badly needs doing lest it should later be done badly.

British civil aviation is an obvious subject of this reply. As soon as war broke out it was, except for our long-distance routes, to all intents and purposes grounded. That was inevitable, and perfectly logical. But it is less easy to see good reasons for shelving discussions of the post-war fate of aviation.

The retirement, under the age limit, of Lt. Col. Sir Francis Shelmerdine, and the appointment of Mr. W. P. Hildred as his successor in the post of Director-General of Civil Aviation, has served to focus attention on the subject of civil aviation and on its new Director-General. Mr. Hildred has had long experience of Government departments, and although recently he was not connected with civil aviation, he *has* had a very close connection with it, having once upon a time been Deputy Director-General (but not, as the official Air Ministry announcement had it, Director-General) under Sir Francis Shelmerdine.

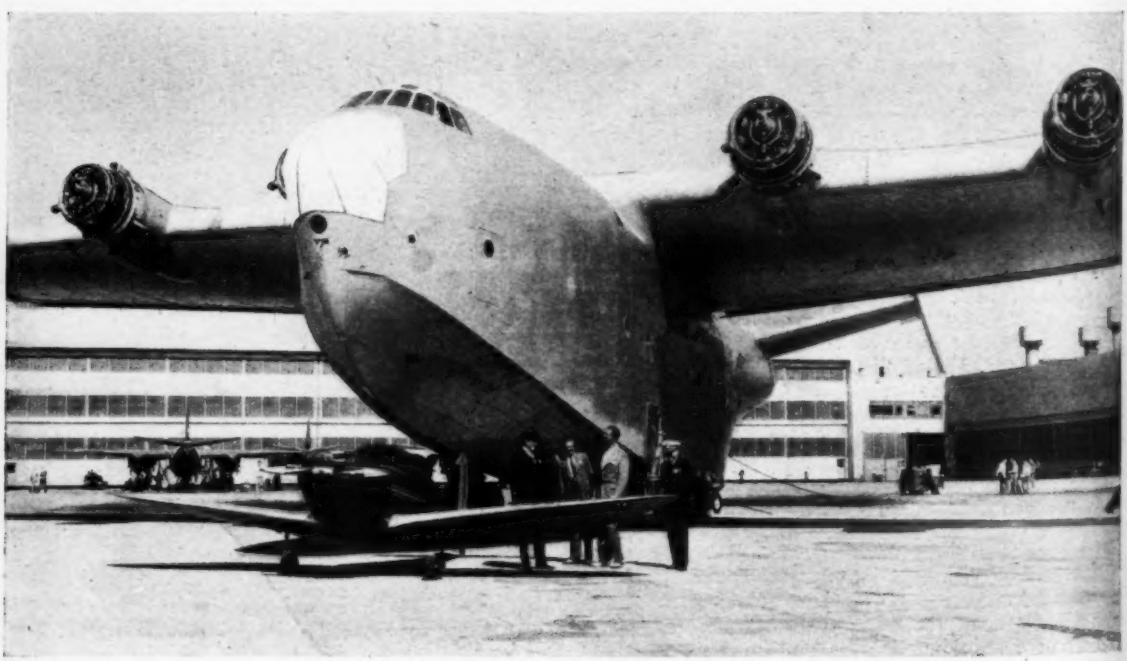
There are in very truth plenty of puzzles to worry him. He is rather in the position of a General Staff which has to map out a number of different plans of campaign before there is even any likelihood of a war. If this task were left until war had broken out, there would be no time to make comprehensive plans, and everything would have to be panic-inspired improvisation. Mr. Hildred must find himself very much in that position. Until he knows how the war is ending he cannot get down to planning on a basis of known facts; he must work out a number of alternative schemes in which every conceivable combination of circumstances is taken into account.

It is to be imagined that he will, if he has not already done so, make the very closest contact with Mr. Arthur Greenwood. As the Minister charged with looking after post-war reconstruction, Mr. Greenwood will obviously have civil aviation under his care, and it will rest largely upon the new D.-G. C.A. to impress upon him the rôle which civil aviation can and must play.

A memorandum was presented by North-Eastern Airways to Mr. Greenwood early this year. We publish it in this issue of *Flight*, not because we necessarily agree with everything in it, but because it does provide a basis for discussion.

Briefly, the memorandum (which, although unsigned, bears the unmistakeable imprint of Mr. Jaques's authorship) pleads for a measure of freedom of the air somewhat in the same way that Great Britain and the United States claim the right to freedom of the seas; but with this important difference that unrestricted and unlimited competition is not advocated. What *is* suggested is that monopolies are bad from almost every point of view.

Two policies are put up for discussion. The first visualises European civil aviation on an international basis; the second is less revolutionary and suggests "zones" of operation. Both are as full of prickly problems as the back of a hedgehog, but they cannot be evaded merely by saying "let us win the war first."



70 TONS TO TAKE THE AIR SOON: The new four-engined Martin flying boat is now nearing completion for the U.S. Navy and will be flight-tested this month. The Service designation is the XPB2M-1, but in the Martin series she is the 170. The new boat has a wing span of 200 ft. and an overall length of 170 ft. A crew of eleven will be carried, and the boat will have six gun turrets. The equipment includes a collapsible tender with outboard motor, and several rubber dinghies. The four engines are of 2,000 h.p. each.

DAYLIGHT SWEEP : A formation of Hurricanes on their way to Occupied France.

Moscow Bombed : The Oil of South Russia Threatened : Hudson's Great Feat in Norway Fjord : Good Cheer for Nantes

THE German advance towards Moscow has brought the *Luftwaffe* bombers within easy range of the Russian capital, and consequently the air raids on the city have grown more frequent and more destructive. When first the Germans tried to bomb the place they had to make flights from some base far distant, and had to choose the least distant of all their bases, so the defence knew in advance the direction from which the raiders would approach, and took appropriate measures to deal with them. In those days the defenders, both fighters and A.A. guns, had a distinct advantage. That advantage has now gone. Considerable damage has been done in Moscow, but the military value of it has not been great. Though detailed information is scant, we are told that the Germans now raid by day as well as by night. We do not know the number of the latest types of Russian fighters which are now in action, and the older types are hardly likely to be able to deny the sky to the enemy by day in the way in which the Spitfires and Hurricanes drove the Germans off or down in the Battle of Britain last year. Hurricanes are certainly reaching the Russian forces now in a steady flow, and though observers say that Russian pilots are as quick as any in the world in learning to fly new types, still there must be a certain pause between the delivery of a dozen Hurricanes and their appearance in the battle line.

ON GUARD : Airfield defence troops for the R.A.F. in Russia are provided by the Soviet Army.

The defence of Moscow is apt, naturally, to absorb the popular attention in this country. Everybody is wondering whether the city will go the way of Warsaw and so many other capitals, or whether it will prove to be another Ypres or Verdun, which the Germans seemed likely to capture in the last war, but which never fell. No doubt the public in Germany is looking on the great assault in much the same way, the younger people remembering only Warsaw, Paris, Amsterdam, Belgrade, and the rest, while the older ones recall how vainly the German hordes flung themselves at Ypres and Verdun, and were hurled back with enormous losses.

This tends to distract attention to some degree from the dangerous advance of the Germans in the South. There they are evidently trying to get towards the Caucasus with the object of cutting the supply line to Russia through Persia, and also of capturing the oil supplies in that region. Strategically this southern movement may be of more importance to the future of the war than is the threat to Moscow. The Russian armies, we all hope, will be able to continue fighting even if the Germans should capture their capital, but to do so they must be able to get supplies from Britain and the U.S.A., and so each supply line becomes a matter of first-rate importance. Possession of oil lines and wells is also of prime importance. The Southern Ukraine and the Sea of Azov are on about the same latitude as Bordeaux and La Rochelle, and campaigning is usually possible until about Christmas. Marshal Timoshenko has a hard task to reorganise the Russian armies in the South, and

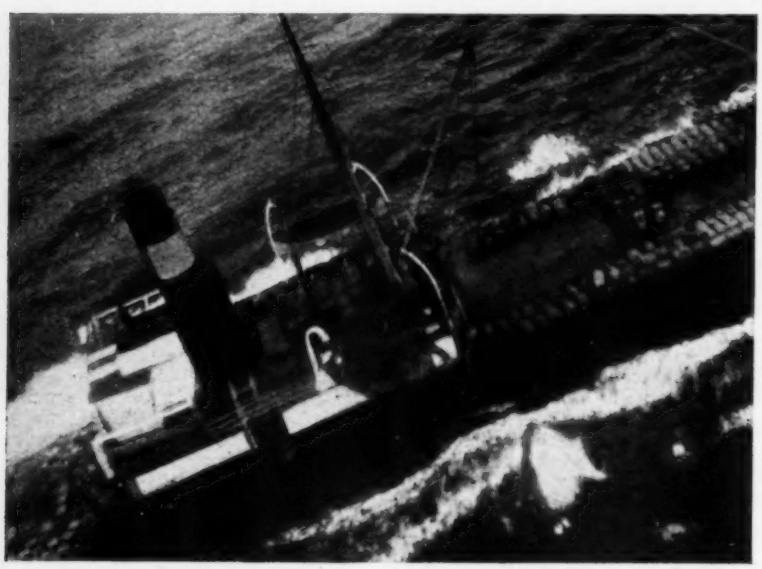
WAR IN THE AIR

so for a time we cannot but feel anxious about that section of the series of battles in Russia. If the supply line is held intact until next spring, there may be important developments in that region.

On the other fronts, news for some weeks past has followed a set plan. The R.A.F. Bomber Command has been bombing Hamburg, Bremen, and the other well-known targets, with occasional trips farther afield. The Coastal Command has been attacking enemy shipping along the coast from Norway to France. The Fighter Command has been making sweeps over France, and also steadily increasing its night attacks on enemy airdromes. The Battle of the Atlantic has been continuing by sea and air. The Middle East Command has been bombing Tripoli and Benghazi, and also raiding airdromes in Sicily, while the Fleet Air Arm has joined with it in sinking and damaging enemy transports on the way to Libya. Each individual sortie is important, and great bravery and determination is shown on each, but a list of all the raids would make wearisome reading. It is more interesting to read about one or two of them in some detail. Let us start with a brief account of the return of a Halifax four-engined bomber from Hamburg on a bad night.

The great machine flew off, keeping above the cloud banks, for the crew knew that ice and electrical storms lurked within the masses of cloud. It was very cold, and fingers and toes suffered bitterly. They had turned on their oxygen from the moment that they started to climb. They could not find their primary objective, and had to turn back. The navigator afterwards told the following story: "The captain had opened his window to get a better vision and his eyebrows were solid with ice. A freezing draught tore in. The temperature was so low that it was off the 'clock,' which could register '30 below.' But we still had to climb to keep out of cloud and away from the moist icy particles which smothered the engines. Suddenly someone called out, 'Our wing tip lights are on,' but we weren't as careless as that. An electrical storm was lighting the tips of our wings; it was slinging blue flames from the airscrews and sending little streams of sparks from the ends of the guns. The electricity scuppered our wireless set. We were glad when we got free of that storm. Through a gap in the drifting clouds we saw the flare paths of an enemy airdrome. We made our bombing run on that and dropped all our bombs. We saw them burst. We sailed on. . . . The second pilot took over as the first captain's fingers were frozen and had to be rubbed. 'It hurt like hell,' he said afterwards. 'I switched off my microphone to muffle my howls from you chaps.' I knew all the same that he had cut down his own oxygen to make more for everyone else. We kept above clouds until through a wide break we saw England. But there was still dirty weather about, and it was a job to find our feet with our wireless out of action. But our navigator was good, and we made our own flare path at last."

O.C. AIR FLEET II: Field Marshal Kesselring with some of his staff officers on the eastern front. His headquarters are located in a railway restaurant car. For tours of inspection he uses a Fieseler Storch.



A NEAR MISS: A photograph of a German supply ship taken from a Beaufort which has just bombed it from mast height. The bomb has cut the lifeboat davits and gone into the sea, as indicated by the large white splash in the foreground.

A Grand Hudson Exploit

THE Coastal Command had pride of place in the news last Thursday. The exploits of its aircraft included a gloriously successful attack on shipping in the harbour of Aalesund, in Norway, bombing of the docks at Bergen, and shooting down an enemy bomber off the south-west coast of England next morning. The greatest success was achieved by a squadron of Hudsons which visited Aalesund by moonlight. So far as it is possible to estimate, the record of the squadron's raid is:—Four supply ships sunk or left sinking; one ship left in flames; the super-structure and upper deck of a sixth ship blown into the air; an escort vessel of the corvette type severely damaged by bombs; a fish-oil factory ablaze; a German barracks effectively machine-gunned; a wireless station or power plant bombed; a construction and repair works set on fire; and a German transport lorry driven off the road.

Conditions over Aalesund were ideal, and the ships were bombed from mast height. Almost every crew said they had hit a ship. Flames from the ships were reflected in the water, and clouds of smoke were billowing round the tops of the snow-covered hills at the back of the town.

"The burning ships far outshone the moon," said one pilot, "and I am certain that the harbour at Aalesund must be completely blocked this morning."

One crew had the satisfying experience of seeing a large ship sink a few minutes after they had bombed it.

The people of Nantes heard a message of hope and ultimate deliverance

ENEMY AIR LOSSES TO NOV. 1st.

	Over G.B.	Over Continent	Middle East
Oct. 26	0	0	1
" 27	2	8	0
" 28	1	3	0
" 29	0	0	0
" 30	1	0	1
" 31	1	0	0
Nov. 1	6	0	0
	11	11	2

Totals : North and Russia, 5,532 ; Middle East, over 2,147.

THIS IS STUMPFF : The commanding officer of the Luftwaffe Air Fleet on the northern and Finnish fronts, in conversation with Brig. Gen. Lindquist, commanding officer of the Finnish Air Force. Obviously, from the name, the Finnish C.O. is a Swede, or of Swedish descent.

for France one night recently when a force of Beauforts of the Coastal Command flew low over the city as dusk fell. The town is surrounded by German troops and is where the 50 hostages were in prison.

As the Beauforts skimmed in from the coast at a low height, they were greeted by a series of lights from the ground. Sometimes the lights came from doors that were suddenly flung open: sometimes houses lit up as though the black-out curtains had been torn aside from windows.

"At one place," said one of the pilots, "we saw a 'V' sign laid out on the ground with oil lamps. There was one house where the door opened and someone inside flashed all the house lights quickly on and off until we had gone over." The docks were then bombed.

During the week end, that is to say on the nights of Friday and Saturday (in each case including the ensuing morning) the Coastal Command bombed or torpedoed 13 more enemy ships, making a total for three nights' work of at least 20 enemy vessels, not counting "possibles" and "probables." On Friday night 11 ships were certainly hit, six of them by one Canadian squadron. Hudsons, Beauforts and Blenheims were all in the air that night and took part in these operations. Several other ships were attacked and may have been hit, but it was not possible to observe the results. One Coastal machine was lost in the night's operations, and another, which was on normal patrol, failed to return. On Saturday night the Canadian squadron bagged two more for certain and probably hit others. On each night a single Beaufort launched a torpedo attack on a ship off La Pallice, and both were probably destroyed, though the actual hits could not be observed. No Coastal machines were lost on Saturday night.

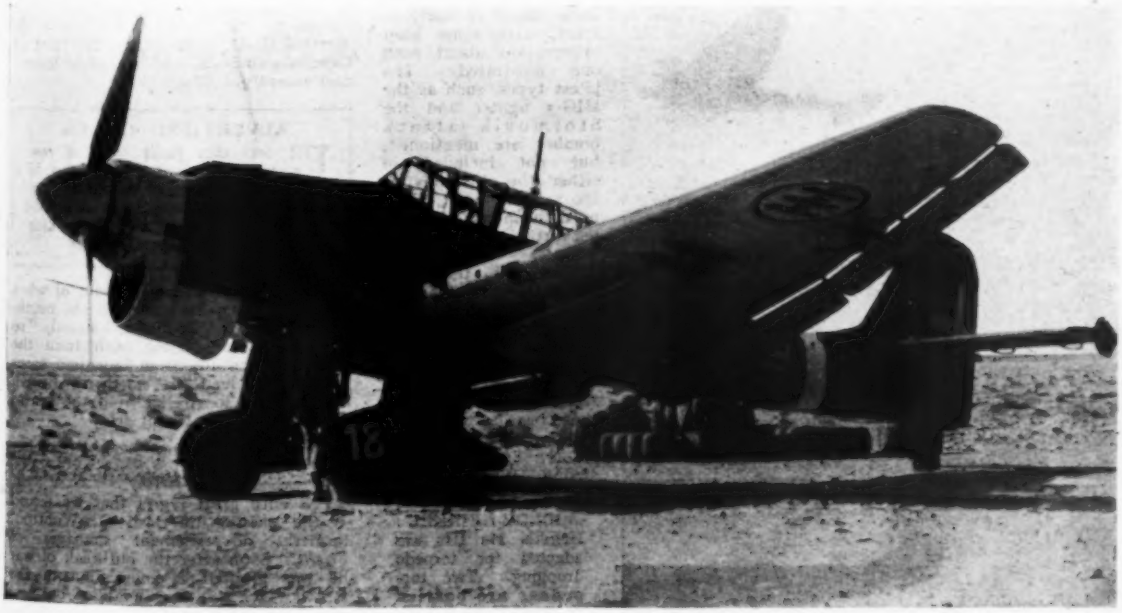
Sir A. Sinclair sent congratulations to the A.O.C.-in-C., Coastal Command.

On Saturday night London heard the "Alert" sirens wailing once more after three months of quiet. It was later reported that only two or three enemy aircraft passed over the Capital on their way to some other place, and did not drop any bombs in the London area. The A.A. guns went into action. It was afterwards announced that a small number of bombers crossed Great Britain by various routes to congregate in the North West of England. A certain amount of damage was done on Merseyside, and there were some casualties. Two places on the South Coast also suffered. But the raiders paid heavily, for six of them were brought down, which was a high proportion of the numbers in action.

BRITISH AIR LOSSES TO NOV. 1st.

	Over G.B. A'crft.	Over Continent B'brs.	Ftrs.	Pilots	Middle East A'crft.
Oct. 26	0	4	2	2	1
" 27	0	2	9	9	0
" 28	0	0	0	0	0
" 29	0	1	0	0	1
" 30	0	0	1	1	6
" 31	0	8	2	2	0
Nov. 1	0	4	0	0	0
	0	19	14	14	8

Totals : North and Russia, 2,943 ; Middle East, about 453.



ONE OF TEN : Recently 10 Junkers Ju 87's, flown by Italian pilots, force-landed near the frontier in the Western Desert. There was some suggestion that the German ground crews had only half-filled the fuel tanks, but it may be that the Italians half-emptied them.

HERE AND THERE

Far East Clipper Service Extended

DESPITE all the many wartime activities, the regular passenger airline services in the Far East are steadily expanding.

Since October 15th, Pan-American Airways have turned their fortnightly Clipper service to Singapore into a weekly service, and to keep time with this progress, K.N.I.L.M. are running a weekly service to the Straits, leaving Batavia every Tuesday.

R.A.F. Parade

A COMPACT but surprisingly comprehensive survey of the war activities of the Royal Air Force is contained between the paper covers of "R.A.F. Parade" which has just been published at the price of 1s.

With a foreword by Sir Archibald Sinclair, Secretary of State for Air, this little booklet outlines the work and achievements of Fighter, Bomber, Coastal and Training Command and the W.A.A.F., and also gives illuminating glimpses into a number of special aspects of the whole mighty business of Britain's aerial operations, both offensive and defensive, including such important matters as the Empire Air Training Scheme, Army Co-operation and the contributive efforts of the Dominions and Colonies and the American aircraft industry.

The story is largely told in pictures, of which there are more than 100 in its 64 pages, and though, as Sir Archibald Sinclair says, "the work is still going on," this record of achievement should prove yet another official best seller.

New Hawker Director

MAJOR HAROLD LAVERS ARMSTRONG, general manager of Hawker Aircraft, Ltd., was elected to the board of directors at a recent meeting.

Empire Air Training

AIR VICE-MARSHAL G. O. JOHNSON, deputy chief of Canada's air staff, has announced that "a new and greater blueprint" of the British Commonwealth Air Training Plan has been handed to the Royal Canadian Air Force. Facilities called for under the original agreement are virtually completed, yet to-day the Air Force is "very nearly as busy on construction of new air fields and new schools as it was when it swung into peak construction under the original plan.

"The Air Vice-Marshal said that "largely because of Britain's complete satisfaction with training operations in Canada, the plan is being very largely extended," and that "all across Canada schools will arise on still unbroken ground."

The number of pilots, gunners and observers being turned out from existing schools is also being increased, and young Canadians continue to be taken on by the Air Force in thousands every month.

U.S.S.R. Air Fleet

TABULATED details of fifty-two types of aircraft (with inevitable blanks here and there) used by the Russian Air Force are contained in a folder prepared by John Stroud and published by the Rolls House Publishing Co., Ltd., for the A.T.C. Gazette.

Additionally there are general arrangement drawings (the customary three views) of thirty of them, with some brief information about each one illustrated. The latest types, such as the MIG-3 fighter and the Stormovik attack bomber are mentioned, but not included in either the drawings or the tabulated list, since no data on such types is yet available for publication.

Some of them, of course, are familiar designs built under licence from Fokker, Heinkel, Dornier, Macchi, Savoia Marchetti, Douglas, Consolidated, Vultee and Republic, and most of those bearing the initials of the now liquidated A. N. Tupolev bear a strong Junkers stamp with a notable exception in the ANT-25, which is a long-distance monoplane of positively sailplane proportions.

While no list of Russian aircraft can expect to be complete, this folder supplies sixpennyworth of useful information.

MOULDY HEINKEL: Heinkel He IIIs are adapted for torpedo dropping. Two torpedoes are carried externally, one each side of the fuselage under the wing centre section.

NOW IN KUIBYSHEV: Sir Walter Monckton, Director-General Ministry of Information, about to emplane to meet M. Lotovsky, his opposite number in Russia.

Pacific Air Defence

CANADA and the United States are taking joint action to provide all defence against any possible attack on Alaska or the Pacific Coast, Air Vice-Marshal G. O. Johnson, deputy chief of Canada's air staff, said in a radio broadcast recently.

ADVERTISED GOODS

THE fact that goods made of raw materials in short supply owing to war conditions are advertised in this journal should not be taken as an indication that they are necessarily available for export.

"Canada is building a chain of what we call staging airdromes in the northwest," the Air Vice-Marshal stated, "so that fighter squadrons both from the United States and from Canadian bases may be moved to northern British Columbia or to Alaska from the centre of the continent without delay."

Obituary

IT is with great regret that we record the passing of Basil G. Wootton, formerly advertisement manager of *Flight*. Soon after the outbreak of war he was granted a commission in the R.A.F.V.R., but was invalided out last year. After a long illness he died at the home of his parents, Cleevehill, Cheltenham, on November 1st. We extend our sincere sympathy to his wife and parents.

Topics of the Day

LET US INVERT

Some Casual and Not Very Serious Remarks About Aerobatics : The Modern Technique : An Illusion Dispelled

ALTHOUGH I rarely find the moral courage to admit it, I'm one of those not so very uncommon pilots who really rather dislike aerobatics of any kind. Consequently, like the rest of my breed, I have always managed to find very good reasons for thinking that such things are overrated and even unnecessary. As a non-aerobatic pilot it is as easy to explain why aerobatics are comparatively useless as it is for an enthusiastic slow-roller to explain at great length why they are absolutely essential in flying, and particularly in war flying.

In fact, they are not essential, but are rather similar in effect to the very curious things one learns at school in order to exercise one's brain. As an infant you can argue your head off, but the "useless" lessons remain on the agenda; as a grown-up pilot you can talk until you are black in the face, but the aerobatic business still remains part of the curriculum of training. In each case the Powers That Be are absolutely right. Strange mathematical fancies and extremely dead languages *do* exercise the brain, and aerobatic flying *does* improve the pilot's technique and mastery of the art of flying. The fact that you hate aerobatics (or mathematics) is the most important reason why the lessons should be proceeded with. People who love aerobatics should, I think, be discouraged and made to do long and tedious cross-country journeys during their advanced training period.

Clean and Clever

Because I rather dislike finding myself in ridiculous attitudes while flying aeroplanes, from time to time I take a firm hold on myself, climb to a prodigious and unnecessarily stratospheric altitude, take a deep breath, and roll the thing slowly on to its back. The first roll invariably results in a vast loss of height and I usually emerge, rather red in the face, with the nose pointing some thirty or forty degrees off the original course. That makes me so cross and ashamed that I spend the next quarter of an hour slow-rolling, half-rolling off loops, and devising sundry ugly manœuvres of different kinds until I really begin to enjoy myself and to feel that I can do it all quite well. And that is why aerobatics are such a good thing. Done well and cleanly they make the pilot feel prosperous. The entire flying situation, consequently, is under better control.

Fighter Controls

And to those who (for their sins or because they are good instructors and are, therefore, the salt of the earth) are tied day by day in the front seats of *ab initio* training types, I may say that it is very much more difficult to do good, clean aerobatics in a Tiger Moth than it is to do them in a Hurricane or a Spitfire. So when the circuit and bump expert's little friend comes down and proceeds to follow a shoot-up (highly illegal) with a half roll off the top or a series of upward rolls, the said c. and b. expert need not feel small. Given an hour's practice in the type he could do it just as well.

The only thing I can remember about the somewhat horrifying moment when I first forced myself to do a roll in a modern fighter was my surprise at the ease with which this beastly manœuvre could be done. After playing about in light areoplanes, the extra nine hundred horse-power or so and the vastly improved control characteristics make the whole affair ridiculously easy—so long as you remember how very much control you have at your disposal and don't break the ailerons by trying to roll too fast or "flick" the machine through too violent a use of elevator during a loop. That last is the only real danger in low-altitude aerobatics. So much speed is available and the aeroplane is so clean that engine failure at a critical moment will make very little difference. If the first half of your loop is too gradual there may not be enough speed left at the top to do a half-roll—and not enough space to complete the loop; and if you pull too hard the infernal thing may suddenly elect to do an upward flick roll of such violence that both you and the various structural members are more than surprised, and even hurt.

I once saw someone do a flick roll in a Spitfire. Since his machine was going quite fifty miles an hour faster than it should have been for any such manœuvre it was a terrifying sight. One felt that the whole thing should, by all the rules, have flown into several hundred pieces. Do you remember the flick rolls of the Bücker "Jungmeisters" at the various international flying meetings in Europe before the war? Rather like that. The only time I've ever carried out a flick manœuvre in a modern type was by accident. The sensation was deeply unpleasant—particularly as the machine was pointing upwards at the time. Like looking over the tail of a Moth in a spin. Sickening in the real sense.

Barrel Out the Roll

The real beauty of the fast machine in rolling evolutions is that there is no need to be upside-down at any time. That, of course, is, not upside-down in the Einsteinian sense. You *are* inverted, of course, just as the people in Australia may at times be presumed to be, but you can remain firmly glued to the seat. At high speeds so little fore and aft movement is necessary to "barrel" the roll that nobody on the ground could possibly see that you are cheating. With a slow aeroplane this movement is so great that the machine uses most of the available sky in a barrel roll and the manœuvre looks like nothing so much as a ham attempt at something or other by an excited first-soloist. A Hurricane or Spitfire hardly shows the barrel. Just pull the nose well above the horizon as you enter the roll and hold a slight backward pressure on the column as you go over, and the roll finishes up—if it is not *too* delayed—quite level, with the machine at its original height and flying at its original speed.

"Barrelling" has two very distinct advantages. The throttle can be left open without the inevitable and technically disastrous "cut" as the machine inverts. And your face is not peppered by bits of iron filings, fluff, dead mice, half-eaten sandwiches, and even odd spanners as the horizon appears the wrong way up. Always disconcerting to the amateur, that inverted shower or rubbish just at the moment when the utmost concentration is required. Nor, after tightening the harness till you can hardly breathe or think coherently, is there that strange gap of several inches between your posterior and whatever this portion of your anatomy was originally resting on.

But I still don't much like aerobatics.

INDICATOR.

ADVERTISED GOODS

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STICKING IT

A New Cement for Joining Fully Cured Bakelite Materials, and a New Method of Securing Economy in Synthetic Adhesives

TWO developments of interest to the aircraft constructor and instrument manufacturer have been maturing for some considerable time, but only now has it become possible to refer to them. Our readers will possibly remember several previous references to the work of Aero Research, Ltd., whose chief is Dr. N A. de Bruyne. Dr. de Bruyne has for many years devoted all his energies to research into adhesives, plastics and kindred subjects, and the latest results of his work, or at least the latest to which reference is allowed, relates to a new adhesive and a new method of using an old.

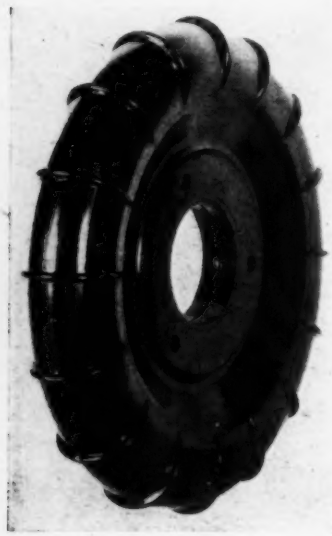
"Ardux" is the trade name given to the new liquid mixture which welds together fully cured Bakelite materials and urea-formaldehyde resins. Our photograph shows a Bakelite moulding, a wheel such as might be used for tail-trimming purposes which is hollow and split down the centre, in the plane of the wheel. The joint along the rim and in the hub is almost invisible, and the wheel has the appearance of being solid.

Making Sound Joints

It is claimed that "Ardux" makes it possible, for the first time, to make really sound joints between moulded or laminated synthetic resins. The material should be a great boon for making up instrument panels in laminated (and therefore non-mouldable) resins. All bushes, bezels and the like can be cemented on with a strength as great as that of the parent material. "Ardux" is a liquid mixture which is applied to the surfaces to be joined; these are then clamped together with ordinary carpenter's clamps, and the article is stoved at 140 deg. C. No preparation of the surfaces, such as brushing or scratching, is necessary.

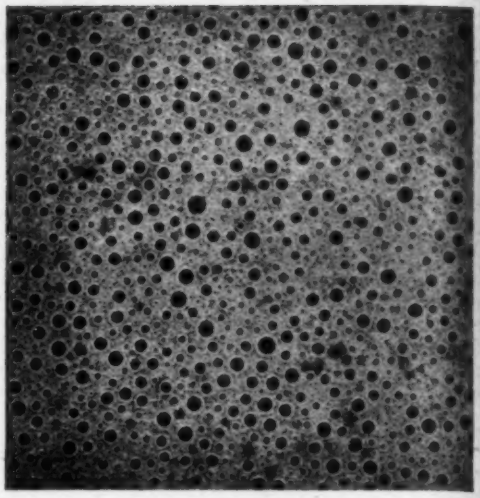
The second development referred to above relates to heating urea-formaldehyde glue (so modified as to make it resistant to three hours' immersion in boiling water) into a stiff foam in order to increase its "spreadability."

Enormous quantities of natural glue are, of course, still used in the woodworking industries, but there is one important branch—the manufacture of plywood—where, in this country at least, natural glues have been completely supplanted by synthetic.



A Bakelite moulding, split down the centre, which has been joined with "Ardux."

Plywood is made to one of two specifications, either D.T.D.427 or B.S.S.5.V.3, requiring resistance to three hours' immersion in water at 60 deg. C. (140 deg. F.) and 100 deg. C. (212 deg. F.) respectively. At present urea-formaldehyde resins are used for D.T.D.427 plywood, and Tego film (paper impregnated with a phenol-formaldehyde resin and used in a dry state) for the 5.V.3 plywood. On the whole, the phenol-formaldehyde resins are more water resistant than the urea-formaldehyde resins (though these can be given sufficient water resistance to meet the three hours' boiling test of specification B.S.S.5.V.3 by the use of certain modifying agents), but they need higher pressures and temperatures to set them than do the urea-formaldehyde resins.



Urea-formaldehyde glue ("Aerolite F.67") beaten into a stiff foam. Magnification × 120.

Although modified urea-formaldehyde glues meet the requirements of B.S.S.5.V.3, they cannot be used in the manufacture of very thin plywood because of the swelling caused in the thin veneers by the wet glue and because of the penetration that takes place after subsequent pressing. The phenol-formaldehyde film type of glue is, of course, immune from these troubles.

Reducing Cost

To meet this difficulty, and at the same time to reduce costs, Aero Research, Ltd., have introduced a foamed modified urea-formaldehyde glue, which, in many respects, combines the advantage of liquid and of dry-film glues, with the added advantage of low cost.

The idea behind this process is that, provided penetration of the glue into the veneers is obviated, only a very thin film of glue is needed to make good joints, and the amount of glue applied by any ordinary means (glue spreaders or brushes) is in excess of the optimum amount. By using the glue in the form of a foam of about the same consistency as the lather produced from shaving soap an extremely thin uniform spread is obtained in terms of pounds of glue per square foot, although the glue layer has an appreciable thickness. Actually, the volume of the glue is about doubled by a special beater machine before it is poured into the glue spreader. Under ordinary factory conditions, without taking any special precautions, it is possible to get a spread of 1.35 lb. of glue per 100 sq. ft.

This foamed-up Aerolite glue is known as "Aerolite F.67," and gives plywood meeting the requirements of specification 5.V.3. Because of the nature of the foam, it can be used with thin veneers without producing excessive wrinkling or causing overlaps in the cores. The foam is allowed to dry on the veneers after it has come through the rollers of the glue spreader. It does this very quickly.

The press temperature required is 90 deg. C., so that steam-heated presses are unnecessary, and the older type of press so common in this country with hot-water heating can be used. The use of pressing temperatures below 100°deg. C. obviates any risk of overheating of the wood with its attendant troubles.

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FRIEND or FOE ?

Two Rival Flying Boats : Sunderland and Do 26

SUNDERLAND : Tall, symmetrical fin and rudder ; tapering cantilever tailplane ; rear gun turret.

BOTH these flying boats have one aspect in common: they are developments of civil types. The Short Sunderland is a direct descendant of the Empire class flying boat and the Dornier Do 26 was originally designed for the North Atlantic mail service of the Deutsche Lufthansa, and only quite recently has it been adapted for military or naval use

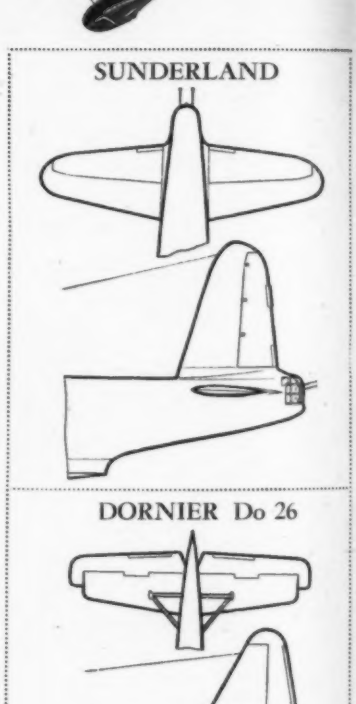
Its chief characteristic is the absence of sponsons, or sea wings, which are found on all previous Dornier boats, retractable stabilising floats being fitted beneath the wings instead. The wing of the Do 26 is gulled, the cantilever centre section being built integral with the hull and carrying the engine nacelles at its extremities.

Its four engines being arranged in tandem pairs provide a very useful means of identification from the rear, since one or both of the two pusher airscrews will be clearly visible, added to which its hull is far more shallow than that of the Sunderland and, having no gun turret in the rear, it tapers off to very slim proportions at the tail.

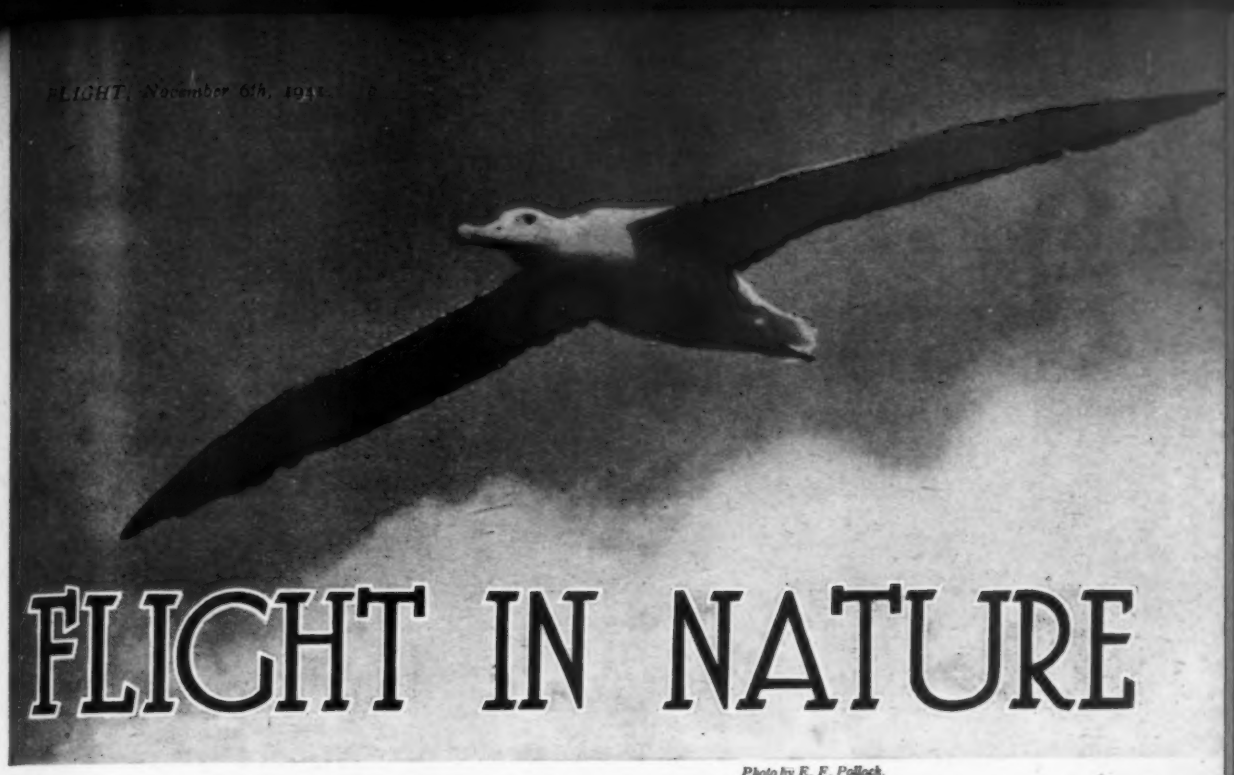
Most distinctive among flying boats is the tall, symmetrical fin and rudder of the big Sunderland, with its power-operated gun turret immediately behind and level with the cantilever tailplane. It will be noticed that the rudder has no horn balance, but is set in below the rounded apex of the fin, two trimming tabs being widely spaced on its trailing-edge. The tailplane of the Sunderland conforms to the general plan of its wings, and is nicely tapered on both edges to small round tips.

The general appearance of the Dornier tail unit is characteristically German. The fin and rudder have a straight taper on both edges—the leading-edge taper is the more pronounced—the whole of the rounded apex being part of the movable rudder, and thus provides a horn balance. The tailplane, which is mounted on the fin near its base, is rather an untidy affair with its double - strut bracing and horn balances on the elevators projecting half-way across the square tips.

Next Week: The Lerwick and Consolidated 31.



DORNIER Do 26. Straight taper to fin and rudder. Strut-braced tapered tailplane set on the fin with elevator horn balances projecting across its square tips.



FLIGHT IN NATURE

Photo by E. F. Pollock.

The albatross has wings of very high aspect ratio, resulting in an extremely flat glide.

Structural Wonders of a Bird's Wing : Some Comparative Air Speeds : Insects are Supreme Masters of Flight : Bats May Have "Radio Locators"

By FRANK W. LANE

SOON after the war started I suggested to the Air Ministry that an ornithologist, complete with high-speed still and movie cameras, should be added to their staff. As birds have forgotten more about flying than we have yet learned, I thought it highly probable that there might still be an aeronautical tip or two to be learnt from the way of a bird in the air. And aeronautical history certainly seems to support my theory.

One instance must suffice here. In the pioneer days of aeroplanes many valuable lives were lost through crashes caused by air eddies forming over the wings. It was to counteract this danger that Mr. Handley Page invented his now famous "slotted wing" anti-stalling device which has done so much to make aeroplanes safer. If those pioneers had only spent a little more time studying the wing-shapes and structure of birds it would have been discovered that they had the same safety device as the "slotted wing." Moreover, when a fledgling bird first leaves the nest its "slotted wing" is the only part of its flying equipment to be fully developed.

But for a full appreciation of the ways in which a bird is adapted for aerial travel it is necessary to dissect it and examine its structure in detail. A light but strong skeleton, hard bones with hollow shafts, air-sacs to increase buoyancy, and powerful muscles to drive the "engine" (i.e., the wings) are all important factors in making the bird the amazingly efficient aeronaut it is.

In conversation a short time ago with the chief designer of one of our famous aircraft manufacturing companies, he spoke enviously of the wonderful structure of a bird's wing when compared with the comparatively clumsy wing of an aeroplane. The swiftest flying birds have wings which are beautifully adapted for mastery of the air. Streamlined, with a high aspect ratio and with little camber, they are ideal for swift movement through air.

The strong bony keel near the front margin of the wing causes it, during the downward stroke, to "feather" itself and cut the air edge-on. The air is thus glanced in the required direction. The tail, too, plays its part in aerial manœuvres. Perfect muscular control (it has been estimated that a goose has 12,000 muscles to control the action of its feathers alone!) enables a bird to raise, lower, spread or alter the shape of its tail. It is used both as a balancer and rudder, aids in the difficult process of hovering, and helps to tail off the air-stream.

With such splendid flying equipment it is not surprising that birds can carry out aerial manœuvres that leave the most experienced pilot gasping. I have recently been engaged on a study of the humming-bird, with special reference to its powers of flight. Some of the things I have learned have made me wonder anew at the ever-present miracle that men call Nature.

Ultra-high speed cinematography has revealed that humming-birds can beat their wings 75 times a second. The wing-tips move so fast that at some moments they are travelling at 30ft. per second. The films have also revealed that on each downward or backward stroke the wings turn completely over, so that they are actually upside down. A few days ago I received a letter from a humming-bird enthusiast in the States—Robert S. Woods. He calls these tiny birds "Nature's finest pieces of machinery." I had written to Woods

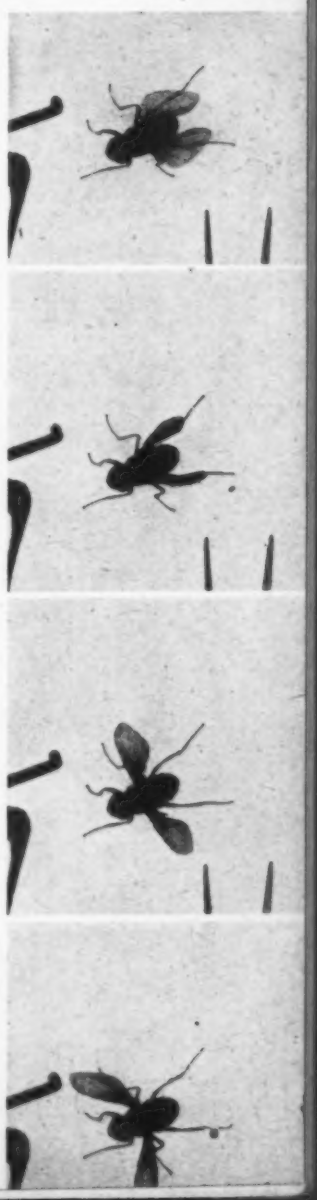


Photo by Institut Marey, Paris.

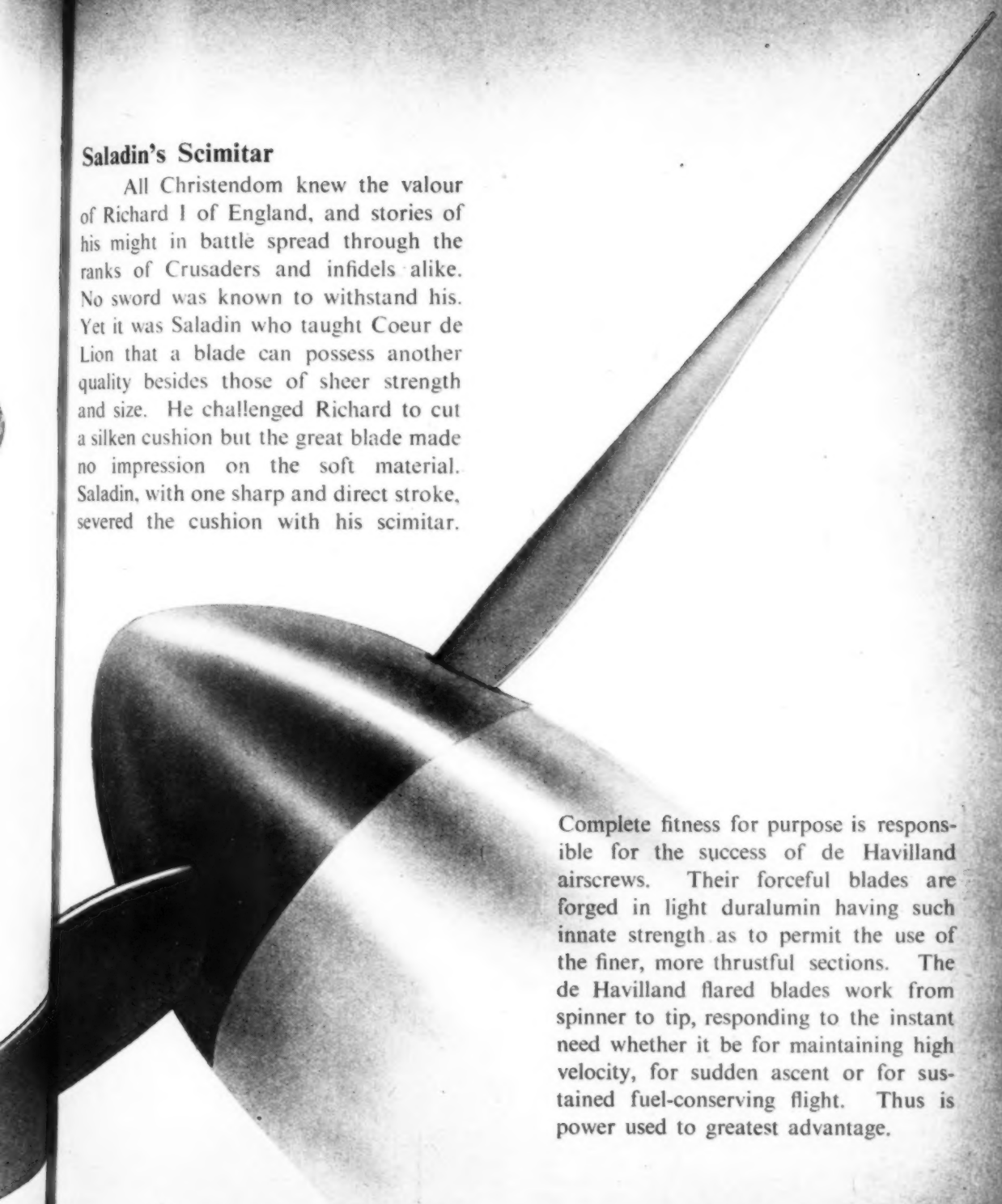
Flight of the common house fly, which seems to "feather" its wings on the forward stroke.

The Roman f
DE HAV

...an of the Blade

Saladin's Scimitar

All Christendom knew the valour of Richard I of England, and stories of his might in battle spread through the ranks of Crusaders and infidels alike. No sword was known to withstand his. Yet it was Saladin who taught Coeur de Lion that a blade can possess another quality besides those of sheer strength and size. He challenged Richard to cut a silken cushion but the great blade made no impression on the soft material. Saladin, with one sharp and direct stroke, severed the cushion with his scimitar.



Complete fitness for purpose is responsible for the success of de Havilland airscrews. Their forceful blades are forged in light duralumin having such innate strength as to permit the use of the finer, more thrustful sections. The de Havilland flared blades work from spinner to tip, responding to the instant need whether it be for maintaining high velocity, for sudden ascent or for sustained fuel-conserving flight. Thus is power used to greatest advantage.

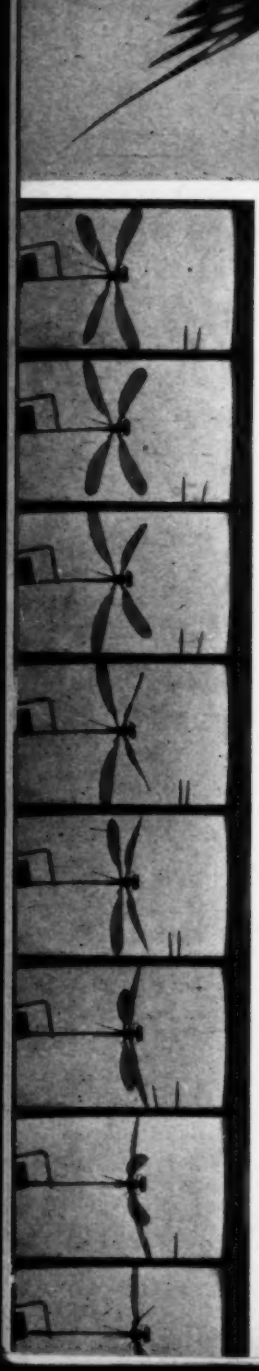
...N AIRSCREWS

Photo by J. A. Speed.

In this remarkable picture of a swallow, the wing slot, or "thumb" feather, is clearly seen.

No reference to bird flight would be complete without mention of the speeds at which birds fly. And here one is always up against a difficulty which the layman often fails to appreciate—the difference between air and ground speeds. But at least such a difficulty largely disappears when the timing has been done by air speed indicator. And here I reproduce a short table which I have compiled from various sources of some bird speeds which have all been timed by an aeroplane's speedometer. I believe the table is unique of its kind.

Bird	Speed in m.p.h.	Remarks
Swan ...	55	
Goose ...	60	
Wild duck (Mallard).	60	For ten miles.
Pintail ...	65	
Teal	68	Chased.
Canvasback duck	72	Chased.
Golden eagle	90	
American cloud swift.	95	Bird circled 'plane travelling at 85 m.p.h.
Lammergeier	110	Bird was nose diving.
Swallow ...	150	I regard this with some hesitation, although other evidence supports the belief that this bird is very fast.
Duck hawk (American peregrine falcon).	200 (probably more).	I believe this to be fully authentic.



because I wanted confirmation of one of the most astounding statements concerning aerodynamics that I had ever come across. This was the assertion that the humming-bird cannot only fly backwards, but *sideways* as well.

This was what Woods told me. "In moving from flower to flower while feeding, the humming-bird shifts up, down or sideways without turning or altering the semi-erect posture assumed while probing the blossoms. However, the most conspicuous example of lateral flight occurs in the courting demonstration used by certain species, in which the male shuttles back and forth in front of his mate, through a space of from one to several feet, always keeping his bill and body pointed towards her. This flight is quite brisk and has no appearance of difficulty. It would not be possible for anyone who has seen it to entertain any doubts as to the humming-bird's ability to fly sideways."

I think it is hardly necessary to add that such feats as these and the many other amazing aerial tricks performed by birds have a definite bearing upon the war in the air—with special reference to tactics. An instance that always comes to mind in this connection is the use by the German Air Force in the last war of what came to be known as the Immelmann turn. Without going into the matter at length, suffice it to say that if birds had been studied more closely, the Royal Flying Corps might have been first to pull that trick in combat instead of the Germans. Several English birds have been seen to perform perfect Immelmann turns while "on manœuvre."

Film strips by Institut Marey, Paris.

Left, the small blue dragonfly gives an imitation of the Autogiro. On the opposite page it is seen taking off.

Birds are the fastest things Nature has created but they are not her supreme masters of flight. That place is held by the insects. Some of the fastest insects can beat their wings up to 300 beats per *second*. And that is no guesswork. High-speed films and other methods of measuring extremely rapid movement have proved the truth of such figures. There used to be a wonderful investigator of insect flight at the College de France in Paris named Magnan. He took films of insects in flight at nearly 30,000 pictures per second. When the films were developed and closely studied they revealed some amazing facts about insect flight. Listen to this passage, in a free translation from the French, from one of the professor's books:—

Flyght Aerobatics

"One sees the creature (a hover-fly) perform real turns in full flight so well that at a given moment the insect is found with its feet in the air, its back underneath. In the same way, I have observed in the natural flight of a fly the performance of a veritable somersault such as aero-

planes do not make. She first takes up a normal position, with the abdomen and feet below, then she quickly makes a rotation of 90 degrees round the axis of her wings, to find herself with body vertical, all the time flapping her wings. At length, after a new rotation of 90 degrees, it is the abdomen and feet which are turned uppermost, wing-beats continuing as usual. The changes are often sudden and happen in a very short time, somewhere about one-thousandth of a second, the somersault, for example, taking place in one-hundredth of a second."

A "loop" in one-hundredth of a second!

The speeds at which insects can fly have been greatly exaggerated. Perhaps the most glaring instance of modern times was in the case of the American bot-fly; 800 m.p.h. was suggested as the maximum speed for this tiny prodigy. Eventually 25 m.p.h. was suggested as a more accurate figure.

Without doubt one of the factors responsible for the wild figures given for insect speeds is the extreme difficulty of measuring their rate of flight. But by means of cinematography, laboratory apparatus and even a Heath Robinsonish contraption whereby insects were actually "harnessed" with very delicate silk harness to the speed-recording device, fairly reliable figures have been obtained for a variety of insects. I append a short speed table.

Insect	Speed in m.p.h.
Mayfly	1
Mosquito	3
Housefly	5
Bluebottle	6
Red admiral	9
Wasp	12
Hornet	13¼
Honeybee	20
Horsefly	30
Small dragonfly	30
Hawk moth	33
Dragonfly (Australian species)	55

The dragonfly is probably the most brilliant aviator in the world. Some entomologists believe that this insect has mastered the supreme manœuvre of flight: the ability to stop dead on a fixed point in the air and then, still facing the same way, dart at full speed either backwards or sideways.

Whether this is the case or not there is no doubt of the marvellous air-mastery of the dragonfly. Leeuwenhoek has left an account of an aerial duel he witnessed between a swallow and a dragonfly in a miniature 'drome 100 feet long. The swallow was trying to capture the insect, but the fly completely outflew its avian foe. The dragonfly flew with such speed and turned, banked and twisted with such speed and perfection that the swallow, although it tried every trick in the aeronautical book, could neither trap nor overtake its prey.

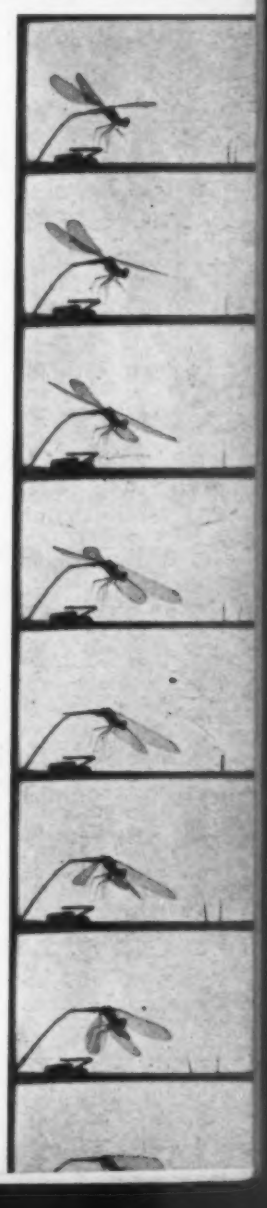
The only mammals which possess the power of true flight are the bats. And the aif mastery of the most expert flying bats is superior in some ways to that of birds. A small bat has been known to catch flies in the air while burdened with young. I doubt if any bird could perform a similar feat, and in view of the aerial skill of bats, combined with their renowned yet mysterious air sense, I think a study of bat-flight in some detail will be of interest to all who are concerned with the problems of flight.

Bats can glide for short distances, but have not the ability to soar on outspread wings. Steering is chiefly performed by the wings, which may be partly furled or given a stronger stroke on one side or the other. In one film sequence Dr. Eisentraut has shown how a large mouse-eared bat takes off from its hanging position on a perch. "Instead of letting go and opening the wings as it drops, it first opens its wings and with a quick stroke or two raises

Marsh harrier with young coot in its claws. The digital feathers are probably used for lateral control. Note also how tail feathers are spread for landing.

Photo by Denis-Roosevelt.

Left, a formation take-off of vultures and marabouts in the National Park, Belgian Congo.



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FLIGHT IN NATURE

the body and then lets go. In this bat the film shows that about 11 or 12 wing beats are made a second, and in this time the bat travels about 14 feet. In the lesser horseshoe bat the number of strokes per second is higher, about 16 to 18." Compared with birds, such a frequency for wing-beats is very high.

The most expert flying-bats appear to be the free-tailed bats of the tropics. Their wings are long and narrow and they have a swift wing-beat. Dr. G. M. Allen, in his splendid book, "Bats," to which I cordially acknowledge my indebtedness for help in the preparation of this article, says he has often seen specimens of the free-tailed bats fly high above the buildings of a town with a speed and movement so much like that of swifts that it was sometimes difficult to distinguish them. The bats, however, when pursuing insects, sometimes varied their course with sudden short dives and other aerial manœuvres that seemed beyond the powers of the birds.

Speed of Bats

Not much is known about the speeds at which bats can fly. The smaller of our common bats probably have a maximum speed of some 20 m.p.h., but, as this is quite sufficient for them to catch insects on the wing, they have little need of strong flying powers. A French species of bat is said to have covered a certain distance (not specified in my source) at 31 m.p.h. Bats of a foreign species were once marked with white paint and then liberated 30 miles away from their home cave. The bats were home in less than an hour.

I have never forgotten reading in a Canadian paper that a hoary bat once travelled at 90 m.p.h. Personally, I look upon this record with some hesitation—unless a gale was blowing in the same direction as the bat was flying. But other evidence suggests that this bat is indeed a very strong flyer. The hoary bat is sometimes found in autumn in the Bermuda Islands, some 666 miles south-east of New York. And there is some indication that oversea journeys of far greater magnitude than this are occasionally taken. It is possible, of course, that the bats may rest on board ships and, as some bats can swim, it is just possible that in very long sea journeys migrating bats *may* rest on the surface of the sea for short periods.

The ability of a flying bat to dodge obstacles is well known. This ability is the more remarkable in view of the fact that bats fly about in darkness or poor light and their eyes are small. Incidentally, the old adage about being as "blind as a bat" is quite wrong. Although bats' eyes are relatively much smaller than in mice of about the same size and they are probably colour-blind as well, their eyes are well developed and look bright under close inspection.

But there is little doubt that the main guiding sense in bats resides elsewhere than in the eyes. It is significant

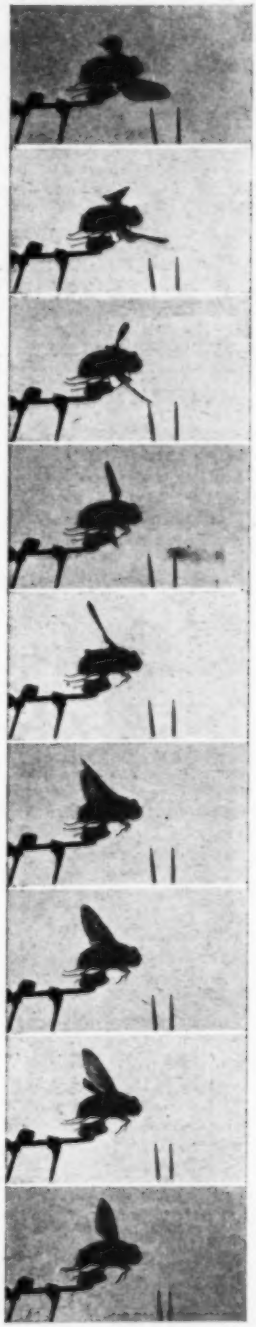


Photo by Institut Marey, Paris

Unassisted take-off of a blue-bottle. Pictures taken at the rate of 2,500 a second.

that many bats have conspicuous growths of one sort or another on their heads. The horseshoe bat has a wide, thin, horse-shoe shaped membrane covering its muzzle, and other bats have a series of small, rounded warts on the lips or small wattles on the sides of the face. Such growths appear to be mostly developed in the insect-eating species. It is possible, therefore, that they act as receivers for air vibrations set up by passing insects or reflected from near-by objects. As the cries of bats are pitched almost above human reception it may well be that the high-pitched buzzing of certain insects sound in a bat's receiver apparatus like the drone of a minute aero-engine.

Writing in *The Australian Museum Magazine*, Ellis Troughton has this interesting passage apropos this aspect of the flight of bats: "It would seem that condensations or slight vibrations of air are set up by acutely receptive nerve-endings in the pointed ear-projection and the fleshy nose-leaves common to many bats, as well as in the coarser 'whisker-hairs' usual in mammals. The reception of such air-vibrations could be likened to the action of a radio set with the numerous hairs acting as aerials implanted in the batteries of nerve-changed tissue."

Dr. Hartridge has advanced a theory which gives another viewpoint on the bat's guiding apparatus. During flight bats are known to emit sounds of short wavelength, and Hartridge suggests that these sounds are reflected from objects in its vicinity, and that, when received by the bat, they convey information concerning its surroundings and direct its flight accordingly.

Blind-flying Bats

As one more illustration of how things, remote in themselves from human affairs, often have a startling relevance, it may be mentioned that Sir Hiram Maxim, acting on the assumption that the membraneous growths on the heads of bats do act in the way Hartridge suggested, invented a device for detecting obstacles in a ship's path at night or in fog. Low vibrations were sent out from the prow and the echo was recorded by delicate membranes on board the ship. Thus has been developed the modern method of making deep soundings by recording the time required for the echo to reach the observer from the ocean bottom.

In an attempt to test scientifically the dodging powers of bats, the American investigator, Walter L. Hahn, suspended a line of thin black wires from the rafters of a room at distances averaging 11in. apart. Bats were then released in the room. Each time a bat approached close to the wires or flew through or appeared to dodge was counted as a trial. In over 2,000 trials with a number of small Myotis bats Hahn recorded 25 per cent. hits.

Hahn then covered the eyes of twelve of the bats with an opaque mixture of lamp black and glue. The animals therefore had to "fly blind." In 600 trials the percentage of hits were fewer than 22, or better than when the bats

(*Concluded on page* 325.)

THE FUTURE of CIVIL AVIATION

A Memorandum Presented by North-Eastern Airways, Limited : Two Policies Examined

Should civil aviation after the war be controlled by an international body, such as the International Air Traffic Association, or should Great Britain take a leading position? Two possible alternatives are outlined in this memorandum, which was submitted to Mr. Arthur Greenwood, Minister without Portfolio, early this year.

THE scope of this subject is so vast, and its potential value as a means of assisting recovery after the war so important, that the proposals in this memorandum must be considered only on the broadest basis. The numerous, at present unknown, factors which will finally influence development must be allowed for. There is no doubt whatever that as soon as hostilities cease an urgent need for civil air transport will arise, and will have to be met immediately.

In planning the civil air transport policy for the new era, the adoption of a plain individual nationalistic policy, such as existed before the war, will bring back once more all the old evils of the past, which resulted in so much frustration and waste effort.

What, then, should be the British policy? What sort of organisation is required to control the civil aviation of the future? When drafting any proposals for the future, must we sweep out of mind all preconceived ideas based on past experiences, or will we find the road to take by studying the past?

The Past

After the last war we had no such problem as this to consider—there was no civil aviation. Air line operation arose from private enterprise. Three operating companies were formed.

It soon became apparent that no air line could survive without financial aid, and these companies were subsidised and ultimately amalgamated. The result was Imperial Airways.

The principles laid down were:—

(i) The gradual diminution of subsidy to the end that civil aviation should fly by itself.

(ii) That overseas air line operation should be the monopoly of one company.

(iii) Internal operators were actively discouraged from extending their lines to foreign countries.

While principles (i) and (ii) were openly avowed, number (iii) was not expressed publicly, but was apparent in every action of the Directorate of Civil Aviation. All attempts by the independent operating companies to extend their services abroad were met by continuous official discouragement and obstruction.

One company only, backed by a powerful financial group, viz., British Airways, obtained official recognition of its foreign lines.

The power of this company in financial and official circles was such that they succeeded in swallowing up the older established company, Imperial Airways, and at the outbreak of war they had in their hands a complete monopoly to develop British civil aviation. They were the "chosen instrument" of the Government for this purpose.

Internal Services

So much for the results of our foreign development policy up to the outbreak of war. With the development of aircraft design and wireless communication, in 1935 and 1936 a number of independent companies sprang into being. From the start they suffered from the opposition of the railways. The travel booking agents were forbidden to book for these air lines under pain of loss of railway business; co-operation of any kind was refused by the railway companies, who themselves operated an internal air service by the method of sub-contracting the work to Imperial Airways, who used these lines as a training school for their junior pilots.

The granting of internal air mail contracts and the belated recognition by H.M. Government of the importance of the internal services was anticipated by the railways, who at once obtained large interests in a number of the independent companies, and a determined effort has been made to obtain the amalgamation of all internal companies under railway control.

Monopoly

Since the outbreak of war, with one exception, only the Railway Associated Companies have been permitted to continue in operation. The exception is Messrs. Allied Airways (Gandar Dower), Ltd., operating to the Orkneys and Shetlands. Such a policy is anti-social and economically wrong. The policy of monopoly defeats itself, as the one "chosen instrument" of the Government is able to "turn the tables" and treat the Government as *its* "chosen instrument."

Air line operation is a highly technical and highly specialised industry. The Government department responsible for the allocation of subsidy must, therefore, draw its knowledge from the operating companies.

If, therefore, there is only one operating company, there can be only one source of information, and there are no means of testing the veracity of statements or their soundness when offered. There is also no "yardstick" to measure relative efficiency.

The Cadman Report stated that the operations of foreign companies would provide the necessary "yardstick." The information they supply is insufficient for this purpose, and comparable statistics are not obtainable. Statistics are fallacious which have not a common basis.

Any tendency to permit air line operation to become a monopoly must be resisted for operational reasons also. Air line operation may be sub-divided into various specialised forms—e.g., operations over water, long-haul services, and short-haul services. There are extreme climatic conditions to be considered, and now stratosphere operations are coming into prominence. The carriage of freight as well as passengers and mails will require special attention.

The resolving of all the problems of specialisation is too great a task to be performed by one management. Obviously, special types of suitable aircraft for these specialised forms are required. Concentration on one task may lead to the neglect of others.

In 1937 the services operated by Imperial Airways were:

1. The Empire routes.
2. London-Paris.
3. London-Basle.
4. London-Budapest (occasionally).

Services 2, 3 and 4 all compared unfavourably with those offered by foreign companies. For instance, London-Basle was operated direct by Swiss-Air, using Douglas D.C.3 aircraft cruising at 185 m.p.h., running twice daily against Imperial Airways' service in two stages, using D.H.86s cruising at 105 m.p.h. and operating most irregularly.

The effect of a monopoly company is also felt upon the design of British commercial aircraft. The most successful modern passenger aircraft is the Douglas air liner. This was the result of the experience of the American operating companies.

An operating monopoly presents its experience to the construction companies through the medium of one mind, and is coloured by the likes and dislikes of that mind. The

constructing company is, therefore, like the Government department, at a disadvantage for want of a parallel stream of experience.

In general, it can be stated that it would be unsatisfactory and uneconomical to rely upon the conversion of military types for civil purposes, except as a very temporary expedient; the objectives aimed at are entirely different.

The personnel of the monopoly company is always at a disadvantage, as the services of its skilled pilots, crews, ground staff and other specialists are of no value outside this one organisation. The monopoly company is always tempted to take advantage of its position by offering inadequate inducements to its personnel.

The Future

In this memorandum we propose to outline briefly two possible policies of development for consideration. We call them Post-War Policy No. 1 and Post-War Policy No. 2 respectively.

The second policy is offered in case it should be decided by H.M. Government that Post-War Policy No. 1 is too far ahead of the times, or is impracticable for political or other reasons. So much depends on post-war conditions, and what form the political and financial structure of things will take when reconstruction is attempted.

Post-War Policy No. 2 is drafted more in keeping with past experience and present conditions, but, like Policy No. 1, it will not meet with the approval of those vested interests which have up to now aimed at establishing a monopoly in air transport.

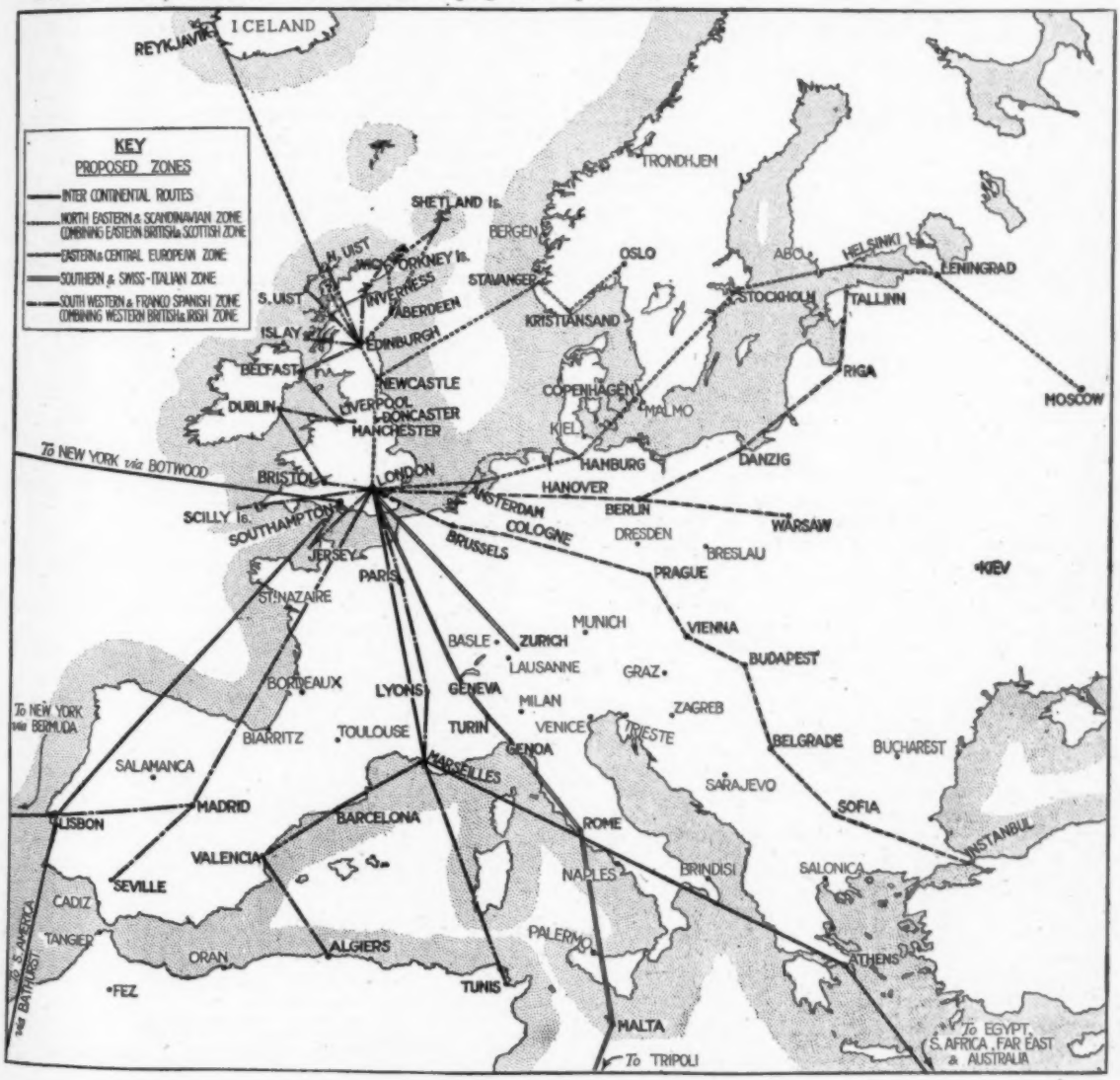
Post-War Policy No. 1

What sort of organisation is required to control civil aviation of the future? The answer will depend entirely on the attitude of the Government towards European reconstitution after the war.

Is every nation to re-establish its own civil aviation department, to reopen the old bargaining for concessions and rights-of-way, involving reciprocity and long-winded negotiations, before any new air route can be developed? We must take the lead and plan European development as well as Imperial development.

In European development consideration will have to be given to the claims of foreign nationals—in fact, the success of European civil aviation development will depend upon our obtaining the fullest co-operation of foreign civil aviation executives and technicians.

Imperial development will also have to provide for the interest which our Dominions will want to take, and their co-operation will be needed likewise. The organisation or organisations to be formed to direct these operations is the problem.



THE FUTURE OF CIVIL AVIATION

It has already been stated that a policy of monopoly is economically and otherwise undesirable, and that efficiency, and by consequence prestige, may be impaired; yet it is necessary to argue that on individual routes a limited monopoly should be applied.

Air traffic is of necessity uneconomic to the operator until a body of traffic is obtained sufficient to justify the heavy outlay on material and ground organisation. It is necessary, therefore, to avoid conflicting services and to prevent the uneconomic carriage of available traffic.

We consider that the ill effects of any limited monopoly created may be offset by departmental control based upon comparative information. The proposals set out in this memorandum are made with these facts in mind.

We agree that with rare exceptions no company can be expected to operate without a subsidy. How will this subsidy be provided for:

(a) The development of European routes;
(b) The development of Imperial routes;
(c) The development of oceanic routes;

leaving out of consideration for the present other routes which do not come under these headings?

Our idea visualises an international governing body being set up for the general reconstruction of Europe, and that this body works for European civil air development through an organisation similar to the existing International Air Traffic Association, whose membership is made up of the individual operating companies.

I.A.T.A.

Before the war there existed an organisation known as the International Air Traffic Association. It was formed to regulate the relations of the air companies of various nations.

The formation of the I.A.T.A. was largely due to the influence of Sir Sefton Brancker, and it is perhaps significant that the official languages of the association were English and French.

Meetings of the association were held annually, and time-table and fares conferences were held twice yearly. The main functions of the association were to maintain the interchangeability and consignment notes between all constitutional members; to fix fares and rates to be charged in the various stages throughout Europe; and to promote the co-ordination of services. Although this country was instrumental in the foundation of the I.A.T.A., it is regrettable that immediately before the war the guiding spirits were the German and Dutch lines. No doubt owing to the distracting importance of Empire routes, British influence was negligible.

Suppose that this association is revived, reorganised, and given wide powers; in fact, that it takes over the task before us. The delegates that formerly attended meetings were the highest executives and technical experts of all the national European air lines; the cream of the brains of all European civil aviation.

Let us assume that British influence takes its proper place as leader of this assembly, and presents to it a carefully drafted plan and layout of European air routes for immediate development when hostilities cease. The operation of these routes should be zoned to conform roughly to national requirements as visualised.

There may be some nations which, after the war, will be too poor to provide finance to subsidise air lines, although, due to the fact that they have formerly operated them, they have valuable executive and technical brains which can be enlisted in the common cause. They will be needed, even if only as agents in their own country, for British operators serving their cities.

Within this organisation, committees and departments would each have their allotted tasks—the control of all being in the hands of the best executive and technical brains of the air-operating world, all of which would be mobilised under this organisation. A full and complete interchange of data, statistics, technical knowledge, etc., would be effected. The closest collaboration between British and foreign nationals would be continuous. As the zones were devised and allocated, care would be taken to see that British interests were fully represented in each and every one.

This proposal, if carefully organised, would make for economy in operation and for service efficiency. It would eliminate unnecessary duplication and prevent any nation building up a large fleet of aircraft for war purposes under the guise of civil air development.

Designers and manufacturers would have a central body with which to deal. A body with every fact and detail available to help in the drafting of aircraft specifications for types to operate specific services or under special conditions, and to advise as to how far it would be possible to standardise types or components of different types.

I.A.T.A. would have its own training establishments and research departments, and it could, under the control of a central international governing body, be made responsible for civil airworthiness regulations.

Imperial and Oceanic Routes

Both Pan American Airways and the Japanese National Company are members of I.A.T.A., and those countries, together with the British companies selected to open all these services, could plan and control them within this organisation on lines similar to those proposed for the European services.

The nations would have to agree to operate only such routes as were approved by the International Air Traffic Association, and to conform to such rules as were made by the central international governing body which, one must further assume, will come into being to carry out post-war reconstruction.

This governing body will, of course, control the activities of the I.A.T.A. in so far as they affect the general policy of European reconstruction, and fresh developments of major importance would have to be approved by them before I.A.T.A. could get them put into effect. It would also receive the proportions of subsidy payable by the different countries and approve its ultimate allocation.

If these proposals are approved, steps should now be taken to bring together a nucleus of experts, including such foreign representatives as are available in this country, so that the organisation can be discussed, and, if possible, its different branches formed and plans arranged to enable operations to be commenced, when the time arrives, with the minimum of delay.

The experts must prepare a programme and make recommendations covering such matters as:—

1. The constitution and powers of the international governing body.
2. Financial structure and powers of the reorganised International Air Traffic Association.
3. What routes are to be operated.
4. Zone operations in such a way that a competitive spirit may be fostered within the organisation to ensure the maximum economy and efficiency.
5. Decide on the types of aircraft required and how they can be obtained.
6. Prepare estimates, etc., etc. There are endless problems to consider.

Post-War Policy No. 2

In the alternative proposal we will assume that H.M. Government are agreed upon the necessity for reviving the operation of air services to foreign countries, and that at the time these services are to be put into operation the Government will be in a position to give great weight to any desired policy.

Operationally, we may roughly classify the services to be organised as:—

1. Transoceanic services.

THE FUTURE OF CIVIL AVIATION

2. Imperial air routes.
3. European routes, with which we will bracket internal services.

When plotting the routes which it is desired to operate we suggest that, as in Policy No. 1, zones of interest are devised and allotted to different companies to operate. This follows upon the theory already expressed that H.M. Government should in each case have the advantage of comparative operation.

1. *Transoceanic Services* should be sub-divided into zones of interest:—
(a) North Atlantic route to New York and Canada.
(b) South Atlantic route to Buenos Aires, etc.

2. *Imperial Services.*—These might be so organised that either the entire route was covered jointly by the British and Dominion operators, or transhipment might be effected at a central point. In any case, the Dominion companies must undertake to divulge all relevant statistical and financial figures.

3. *European Services.*—These should be allocated to different operating companies, each one being given its own zone of interest, e.g.:—
(a) North-Eastern and Scandinavian Zone.
(b) Eastern and Central European Zone.
(c) Southern and Swiss-Italian Zone.
(d) South-Western and Franco-Spanish Zone.

In each of these zones, as finally agreed, the main routes should be designated, but the selected operating company should be free to develop its operations within the zone of interest allotted to it.

We submit that the operation of any one zone such as to justify a British claim to the leading position is a task requiring the complete concentration and resources of one company. Only then will H.M. Government be in a position to judge by results whether an operating company is functioning as it should, and Government control ought to be exercised in relation to those results.

These British-operated European routes are visualised as radiating from London to all the capital cities of Europe, the foreign nationals being left free to operate interlocking transverse routes which would be a great economic advantage to the radial services.*

If this policy is adopted foreign operators will wish to operate parallel services to London as before the war, and the British operating company in its respective zone will then have to enter into agreements for the pooling of such services with the foreign company.

We have already proved that it is impractical to obtain efficient operation of all these services by handing the task over as a monopoly to one organisation.

Reorganise B.A.S.A.

There is in existence an organisation known as the British Air Services Association, of which the Internal Air Operators are members, but, except for the Railway Group, none of its present members is able to operate services to-day owing to war conditions. This association could be reorganised and tackle the problem before us on the same lines as was proposed for International Air Traffic Association in Policy No. 1.

It would be necessary for all the British companies selected by H.M. Government to operate a zone to join this organisation, and it might also include the Dominion operating companies, or affiliate any Dominion organisation of a similar kind now in existence. Undoubtedly, International Air Traffic Association in its old form will be revived and the British operating companies of each zone would require to be members of this organisation also. This would then give British Civil Aviation a far greater standing and representation in International Air Traffic Association than it had in pre-war days, and this should provide the means of co-ordinating all European airline operations.

Internal Services

These services in the past have been restricted in their efficiency by the shortness of their routes, and thereby have been unable to justify the use of aircraft of a type which would have shown results favourably comparable with those of other means of transport.

We suggest that the operation of these services should, where conveniently possible, be zoned and bracketed with the European zones, and operated with the same personnel and aircraft as are used for the Continental routes.

Finance

It has already been stated that, except in rare circumstances, no company can be expected to operate without a subsidy. It has been laid down as a principle that civil aviation should, as soon as possible, fly by itself.

This principle, although economically admirable, must be related to the facts of operation, and due weight must be given to the circumstances in which each service is flown.

For this purpose, services may be categorised as follows:—
(a) Services or routes which in the past have proved to be of worth and value.
(b) Services which are deemed to be desirable in order to obtain the economic value of the rapid carriage of mails.
(c) Services of uneconomic value, but having a value for the purpose of national prestige.

It is necessary that each service should be operated with the aircraft most suitable to the peculiarities of that service, whatever may be the source from which such aircraft are to be obtained.

We suggest that in these circumstances H.M. Government should decide upon those routes which they consider it desirable in the national interest to operate, and that they should be classified for future consideration.

It is a matter of extreme difficulty to estimate the deficit of any service in the first years of operation, and it may be necessary that H.M. Government should guarantee the deficit of the operator over an initial period. As soon as possible the operator should be given a fixed annual subsidy covering a term of years. Operators must be enabled and put under an obligation to maintain a fleet of modern aircraft.

As a safeguard against the payment of excessive subsidies, the selected companies should be rated as public utility companies, being allowed without question, however, to declare a dividend up to a fixed percentage on its share capital.

When profits available for distribution exceed a fixed percentage the excess should be divisible in an agreed proportion between H.M. Government and the shareholders. Accounts of all companies would, of course, be available for inspection by Government auditors, and a comparison of administration charges made year by year. Whatever information and statistics the Government require it would be incumbent upon the companies to provide, and in whatsoever form it might be demanded.

Naturally, the Government would appoint its nominee on the board of each operating company, and would approve the articles of association of each of the companies concerned. These articles could provide that during the continuance of the subsidy payments H.M. Government should in any year in which the accounts show a loss have the right to nominate directors in place of those retiring.

Such further precautions could be provided as the Minister deemed advisable, but a long-term subsidy agreement would be essential if private finance is to be obtained.

*This paragraph should not be construed as implying that the foreign nationals are not to operate main routes parallel with the British Services. Such a policy would give rise to considerable discontent and worse. It might even be considered advisable for this country to assist foreign nationals to re-establish their Operating Companies.

Halifax Squadron

The New Handley Page in Service : Its Size, Comfort and Convenience : Successful Start to Its Career

THE year 1941 has seen the big four-engined bomber come into regular use by the R.A.F. Bomber Command. It is not a new policy but a new development. These monsters—for so we now regard them, though a few years hence they may seem as trifling as we now consider the Southampton flying boat, which was once consistently described in the daily papers as a "giant aircraft"—are certainly expensive to build and expensive in man-hours; but in maintenance and operation they are economical in man-power and pay good dividends in the weight of bombs which they unload on enemy targets for a given amount of effort. Their range brings within the danger area many targets which could formerly congratulate themselves on their immunity. As the number of such machines in use by the Bomber Command increases (as it is steadily doing) many of those distant targets may expect more frequent visits and more widespread destruction.

The sight of the new large bombers naturally sends the minds of older men back to the final stages of the last war, when the Handley Page O/400 was a new and astonishing machine. Those who had seen the first specimens to go into service sometimes told their friends that it was so big that "it frightened you." So it seems only natural and appropriate that the same firm which produced the O/400, the first large machine which any country (except Tsarist Russia) possessed, should be represented in the most recent stage of development by the four-engined Halifax. Of course, there is a great deal of difference between the old braced biplane with fabric-covered wings and fuselage and the new mid-wing cantilever monoplane of all-metal construction.

The Halifax is a bomber which immediately attracts the eye. It looks good, for it is a shapely aircraft for all its size. Briefly, its span is 99ft., its length 70ft., and its height 22ft. The top line of the fuselage is straight, but the line underneath is curved. The plan of the wings is

HALIFAX TRIO : A view looking aft from the front gun turret showing first pilot at the controls, radio operator below and the second pilot who normally sits alongside the first pilot.

rectangular to just beyond the two inboard engines, and from there they taper almost symmetrically, but more markedly on the trailing edge, to the square wing tips. The main wheels retract backwards. The engines are Rolls-Royce Merlins, and the airscrews are three-bladed and fully feathering.

It is most impressive to see the bomb-doors open and to realise the tremendous weight of destructive power which can be accommodated, but details of the bomb load would be information which the enemy would very much like to know, and therefore may not be given at present. Enemy factories have already had some taste of its quality, and it is understood that they have not enjoyed it.

Inside the Halifax one is surprised by the amount of space. One can stand up and walk about easily, and there is no awkward spot where one has to crawl on hands and knees, as in some earlier bombers. This makes for efficiency in operations, and incidentally would make it less difficult to move a wounded man on to the seat where he could lie and receive first-aid. This seat is situated centrally and during take-off the crew can sit on it together. The normal crew is seven.

The Crew's Stations

The stations for the crew in flight are rather unusual. The flight engineer (a new R.A.F. trade) sits in a compartment behind the pilots' cockpit underneath the astro-hatch, and now is trained to take observations, which are passed on to the navigator. The latter and the wireless operator have their station below the first pilot's seat. Down below them is the position for the bomb-aimer, while in the nose is the forward gun turret. These three latter positions are reached by moving aside the seat of the second pilot. A door cuts off the rear portion of the fuselage to exclude draught. The rear gun turret—aptly termed by our American friends the "stinger" turret—can be seen in the illustrations. Near the door is another sort of seat or bunk, which is not normally used as such in flight, but provides some comfort to the guard who sleeps in the machine when it is on the ground.

As is usual in large aircraft, the forward turret has two Browning machine-guns and the tail turret has four. The Halifax, in fact, can make it exceedingly unpleasant for intrusive enemy fighters, and some have already paid the penalty.

GOING TO RACK AND RUIN: Loading up the bomb racks of a Halifax. The bomb load and its variations are not for publication.

A very important point about a long-range bomber is the comfort of the crew. The whole of the Halifax is very well warmed, except for the nose and tail gun turrets. The rear gunner wears electrically heated clothes and part of

OH, MASTER, WE ARE SEVEN: The crew of a Halifax is made up of flight engineer, first and second pilots, wireless operator, navigator-bomb-aimer and two air gunners.

HALIFAX SQUADRON

his protection includes a Brynzie vest made of silk netting, of about 1in. mesh, made of material similar to that of the shroud lines of a parachute. This is said to have especial virtue in keeping the body warm.

Another device inside the Halifax which attracted notice is a hatch opening on to the top of the fuselage, with a ladder of wire cable leading up to it. This is used by aircraftmen to get out on top when the machine is on the ground.

Like all modern bombers, the Halifax inside is a perfect magazine of flares and other items of equipment. The arrangement of the oxygen apparatus is particularly good and is a great improvement on that of some older types. It is easier to work, and avoids risk of leakages of the precious vapour. Naturally it takes a crew some little time to learn their way about and to know exactly where everything is, so as to be able to go to the right spot for it without hesitation. Crew members who have served in Whitleys go for a conversion course on a Halifax before being posted to a squadron which uses this new type. A pilot must have done a certain minimum number of trips in a Whitley as captain of the aircraft before he is considered eligible to be included as pilot in a Halifax crew. The Halifax is popular with the pilots, who find it easy to fly. It is very manœuvrable, which is a great advantage when avoiding *flak* or attacks by fighters.

The Halifax in Action

As official communiqués have told, this new bomber has already made itself felt in numerous raids over enemy territory. It almost goes without saying that it has bombed Bremen and Wilhelmshaven, but the full list of the targets which it has reached is a long one. It includes Berlin, Magdeburg, Mannheim, Essen, Kiel, Stettin, Hamburg, Karlsruhe, Cologne, Dusseldorf, Hanover, Frankfort and Duisberg. Its bombs have spread havoc in the Royal Arsenal at Turin, and the crews much enjoyed the trip over the Alps on both the outward and the return journeys.

One of the greatest, perhaps the greatest adventure in which a formation of Halifax bombers was concerned was the great daylight attack on La Pallice, when the *Scharnhorst* had sneaked off there from Brest. It was bound to be a daring affair, and losses were to be expected, but the object of the raid was to help in winning the Battle of the Atlantic.

R.A.F. bomber crews are never held back by considerations of possible losses, and doubtless as these men made their runs up on to the target they thought that if the *Scharnhorst* were to get loose again she might sink hundreds of tons of British shipping, cost the lives of hundreds of British seamen, and prevent the delivery of large supplies of munitions and food to Britain. At any rate they went in.

During the visit of a *Flight* representative to the station where a Halifax squadron lives, men who had taken part in this fine action described what happened. One said that as their machine approached La Pallice, and was only a few miles off, the bomb-aimer exclaimed "Target sighted," and at once a tense silence prevailed all through the machine every man waiting anxiously for the words "Bombs gone." Then the strain seemed to relax and they resumed their usual activities.

A gunner officer related how he was put in charge of the defence of his machine, after the bombing, to guide the machine back out of the danger zone. He took up his position under the astro-hatch, keeping his eye skinned for fighters up above, while the gunners at each end looked out for enemies below. This officer was, for the time, in command, and the captain of the aircraft obeyed his directions. There were swarms of Messerschmitts in the sky, perhaps 50 or 60 of them, and most of them were of the 109F mark. As each launched its attack, this officer shouted directions to the captain, and evasive action would throw the fighters off their mark. It must have been exciting work, and it required very nice judgment, but it was coolly and skilfully carried out. As a result his machine got home with only six bullet holes in it. The fighters pursued them in vain for as long as their petrol allowed, but finally drew off and returned to their bases.

TO KEEP HIS END UP: A Halifax rear gunner in his four-gun turret.

As is well known, the enemy gave up hopes of getting the *Scharnhorst* away to a dockyard in the south and brought her back to Brest, where she received further attention from night-bombers. The whole country owes a big debt of gratitude to the men and the machines who carried through this fine attack.

Still more Halifax bombers will soon be added to Bomber Command, and perhaps they may be even more formidable as the result of the experience gained through the operations of the forerunners. *Caveat hostis!*

New Uses for Old Journals

WE are grateful to the many readers who have helped us to minimise the inconvenience caused by the restricted circulation imposed upon us by the shortage of paper. We have ample evidence that copies of *Flight* are passed from hand to hand, and that the last man to get them studies them as eagerly as his more fortunate fellows. But even an old copy of *Flight* is not by any means useless, and it is worth while to take a little trouble over the disposal of it by the reader who is last to receive it.

Waste paper is urgently needed for munitions, and readers of *Flight* may like to feel that even when copies have reached that stage, they can continue to help in the war work. One copy will not seem of great importance, but, rather surprisingly, it only takes about 6,500 copies of an average issue to make up a ton; and a ton of waste paper will make, for example, 71,000 of those little dust covers which are used to plug small openings of various sorts in aero engines. The shells fired from aircraft cannon are packed in boxes, and a ton of paper will make 3,000 of them.

So don't throw away your old *Flights* or other journals. See that they are collected by your local council and put to a useful purpose.

BOOK REVIEWS

The Battle of Britain, 1940, by J. M. Spaight, C.B., C.B.E., late Principal Secretary, Air Ministry. (Geoffrey Bles, 10s. 6d. net.)

IT is unfortunate that the title of this book should be nearly, though not quite, the same as that of the official publication which described the attempts of the *Luftwaffe* bombers to beat Britain to her knees last summer. Mr. Spaight does deal with that great air battle which raged from the middle of June to the end of October. Naturally he does not deal with it in quite the same way as the official historians have done, but he gives all the main facts and dates, and adds many incidents and personal stories which brighten up the recital.

But Mr. Spaight does not confine his attention to the defence of this island by Spitfires and Hurricanes. To him the attempt at blockade, the threat to our Atlantic shipping fairway, and the onslaught of our own bombers on Germany's war production, are all part of the Battle of Britain. It all depends on one's point of view.

To those who are familiar with the works of Mr. Spaight it is unnecessary to say that this book is not only sound but well written. Of course, there can be little in it that is new to those who follow the fortunes of the air war day by day, but even for them it makes a very convenient and valuable summary of events. To readers overseas it should prove of absorbing interest.

There is only one point on which we cannot agree with Mr. Spaight, though we are aware that it is a temerity to dispute with an acknowledged authority on international law. On pages 79 and 80 he condemns as "brutal" the action of German and Italian airmen in firing at British pilots when they were descending by parachute, even when the latter were over their own ground and would, if they survived, live to fight again. Surely such an action is a legitimate act of war! If the parachutist were over enemy ground and would be taken prisoner when he landed, then the shooting would be inexcusable. But a parachutist over his own ground is in the position of an infantryman running away, and nobody has ever held, we believe, that it violated any code to cut up a flying army, whether by fire or by sending in the cavalry. In fact, if our own airmen did not try to disable an enemy dropping on his own ground, we consider that they would have failed in their duty. Killing may be distasteful, but it may be a duty none the less.

Despite this protest, we have no hesitation in giving a hearty recommendation to this book.

Guide to Aircraft Recognition. By Leonard Taylor and James H. Stevens. The Rolls House Publishing Co., Ltd., for the Air League of the British Empire. 4d.

MANY publications dealing with the identification of aircraft do not begin at the beginning. They catalogue a wide selection of aircraft, both Allied and enemy, and they detail their external characteristics. But they take it for granted that the reader will already be well enough versed in matters aeronautical to know what to look for and where to look for it. Furthermore, they assume familiarity with technical phraseology and say, for example, that this machine has dihedral from the centre-section, and that one has a backswept leading-edge. This is quite in order for readers of *Flight*, who will be *au fait* with such terms, but there must be very many people who, to-day, wish to learn how to identify aircraft but have no such semi-technical knowledge.

It is in the realisation of this that Leonard Taylor and James H. Stevens have compiled *Guide to Aircraft Recognition* which is, in effect, the learner-spotter's A.B.C. Under the separate headings of Engines, Wings, Fuselages, Tails and Landing Gear, this useful little folder analyses their visible external details and, taking a selection of representative types to illustrate each "lesson," shows the beginner precisely what to seek and where to find it. Having once mastered this spotter's alphabet, the beginner can then study complete aircraft, both on paper and in the air, much as a child gradually learns to recognise combinations of letters after having mastered the 26 individual symbols of the alphabet. The idea is a sound one and, as pointed out in the explanatory matter, one becomes able, in time, to identify an aircraft without consciously noting its details in exactly the same way as one recognises a complete word without consciously noting its constituent letters.

Lessons in Arc Welding. The Lincoln Electric Co., Ltd., Welwyn Garden City, Herts; 3s. 6d., post free in U.K., 4s. overseas.

THIS book makes available to industry and instructional centres the accumulated welding information from the Lincoln Welding Schools, which have been in continuous operation for 24 years.

Helpful both to beginners and to experienced welders, including supervisors and instructors, the book comprises a ready reference on arc welding and a guide to its proper application. It will be particularly valuable to any industrial organisation faced with the necessity of training its own welders.

FLIGHT IN NATURE

(*Concluded from page* 317)

could see. When the ears and tragus of the bats were amputated and they were released in the room they recorded about the same percentage of hits as previously.

Hahn then tried a third series of experiments, this time closing the ear orifice by stopping it with a small plug of plaster of Paris, which he allowed to harden before liberating the animals. At once the percentage of hits increased, averaging about 66 per cent. Evidently the internal ear, with its acute sense of hearing, is a main factor, not only in helping bats to avoid obstacles but also in aiding them to hear the hum of a passing insect.

It is, of course, not sufficient for a bat to be able to detect obstacles in its path, it must also possess the necessary powers of flight and aerial manœuvre to enable it to dodge in a split second. One has only to study the flying of bats to realise that this power is possessed in abundant measure.

The English naturalist, Tomes, has recounted that he once confined a lesser horse-shoe bat in a room and then watched it trying to find an exit. It flew behind and under the furniture, went under a bookcase standing against a wall, where there were scarcely three inches between it and the floor, and then examined some book-shelves in a recess of the room. The bat found a space where one book had been taken out, and it darted into this tiny opening without appearing to touch anything with its wing tips.

But the most amazing example of both the air-mastery and dodging powers of bats is to be found in a classic passage by W. H. Hudson. Hudson tells how he was once walking down a Hampshire lane when two bats appeared, "and always on coming to me they circled round and then made a vicious little stoop at my head. I thought of a way to frighten them. Holding my cane above my head I caused it to spin round so rapidly that it was no longer a cane in appearance, but a funnel-shaped mist moving with and above me as I walked.

"'Now, you little rascal,' said I, chuckling to myself as the bat came; then making the usual quick circle he dashed down through the side of the misty obstruction, made his demonstration over my cap, and passed out on the other side. I could hardly credit the evidence of my own eyes, and thought he had escaped a blow by pure luck, and that if he attempted it a second time he would certainly be killed.

"I didn't want to kill him, but the thing was really too remarkable to be left in doubt, and so I resumed the whirling of the stick over my head, and in another moment the second bat came along and, like the first, dashed down at my cap, passing in and out of the vortex with perfect ease and safety!"

Correspondence

The Editor does not hold himself responsible for the views expressed by correspondents. The names and addresses of the writers, not necessarily for publication, must in all cases accompany letters

NAMES TO INSPIRE

A Suggestion Endorsed

KINDLY allow me to endorse the suggestion by G. A. Chamberlain in *Flight* of October 23rd that the names of our last war Aces are used in the nomenclature of our latest types of aircraft.

I would like to suggest also that the names of the two greatest designers of fighter aircraft—R. J. Mitchell and S. Camm—are included in the list.

These great men were responsible for the development of the Spitfire and the Hurricane, which aircraft saved England in the Battle of Britain last year, and it would be truly fitting if the latest types were named after them.

DRAUGHTSMAN.

STRATEGIC BOMBING

French Plants Producing for Germany

A FEW months ago you published a letter of mine suggesting that our bombers had plenty of scope for operations nearer home, in the occupied part of France. Since then docks, railways and electrical installations have all received their attention.

I am now going to suggest that greater effort should be made to smash the plants which are helping to sustain the mighty mechanised Nazi forces which have been depleted by the Russian campaign.

The following extract from an American business magazine further confirms that this is immediately necessary.

> "Few realise the extent to which Germany is utilising French war industries in the occupied zone. Renault, Farman, Citroen, Peugeot, Schneider, and the other big French war factories are all working 24 hours a day on German war orders. Thanks to plans turned over by Admiral Darlan, the Nazis are getting production of the excellent 33-ton French Somua tanks, and the crack French 47-millimetre anti-tank gun. Other material being turned out by French factories includes six-wheel all-terrain trucks, machine guns, artillery, and grenades. A resuscitated French aircraft industry is now making some 280 planes a month."

W. J. LORD.

JET PROPULSION

Correction and Compliment

MAY I bring to your attention a small mathematical error made by one of your correspondents, O. Lawrence, M.A., in his letter, which was published in your issue of October 23rd?

On page 285 at the end of the second paragraph under his diagram he writes: Inlet velocity to turbine assumed 1,000 ft./sec. Exit velocity = 1,000 cos 30 deg. = 500 ft./sec. This, of course, should read *sin* 30 deg. as the cosine of 30 deg. is $\frac{\sqrt{3}}{2} = 0.87$ (approx.).

I should also like to take the opportunity of complimenting you upon your excellent journal, and I am sure that many others like myself would be pleased to see included in it a few articles on aircraft wireless and radio installations, assuming, of course, that the Censor permits.

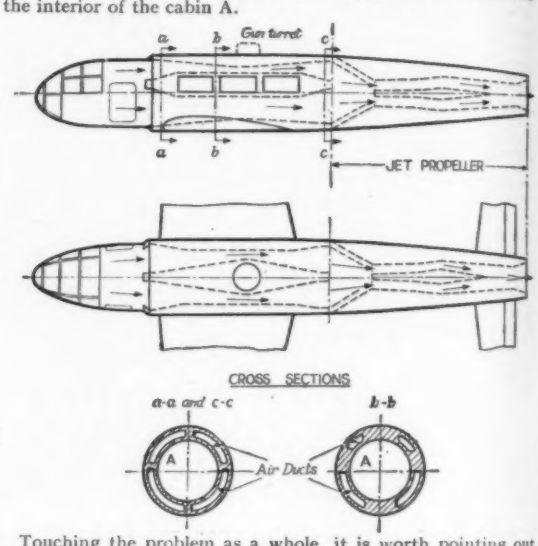
N. F. GRAY.

JET PROPULSION OF AIRCRAFT

Practical Points in Design

FLIGHT has done a good work in giving readers the valuable information of what has hitherto been done in "Jet Propulsion of Aircraft." Looking at the imaginary jet-propelled craft in your issue of October 9th it seems to me that a little change would make it more useful from a practical viewpoint, and this I indicate on the drawing in the next column.

The jet-propelling power plant is accommodated within the rear part of a fuselage. The air, being picked up from the region of high pressure of the fuselage by a circumferential scoop, is conducted in the air-ducts, arranged between two skins of the passengers or crew cabin A, to the intake of the axial flow, rotary compressor of the power plant as indicated by the arrows. The four ducts, being separated and formed as shown on the drawing, permit the installation (among them) of windows on both sides of the cabin, the bomb doors or emergency exit in the bottom and eventually a gun turret on the top of it. All these devices have direct communication with the interior of the cabin A.



Touching the problem as a whole, it is worth pointing out that there is some possibility of charging a bottle or any other container with compressed air when flying in order to use it for initial starting or testing purposes when on the ground by applying a light fuel (petrol) and electrical ignition. This might mean that a starting engine would be quite unnecessary.

W. JAWORSKI.

JETS AND CONTRA-PROPS

Some Suggestions from a Reader

FLIGHT has been even extra-interesting of late, what with the subjects of jet propulsion and contra-props. Taking contra-props first: many years ago I came in contact with a Redrup contra-engine in which the crankshaft rotated in one direction and the air-cooled cylinders rotated in the opposite direction.

This engine was built into the back axle of a car and acted as a differential. The crankshaft was geared to one of the back wheels, and the cylinders to the wheel on the opposite side; and it worked! This construction imposed no torque-reaction on the vehicle.

In any engine in which the crank rotates in one direction the cylinders tend to rotate in the opposite direction. If the crank keeps on turning, the cylinder reaction is there, no matter what the engine is driving; it is independent of whatever the engine drives.

The torque-reaction of the prop is due to the resistance of the air through which it moves. If the power output of the engine is divided between a pair of props rotating in opposite directions, the total torque output is divided between them, and the reaction due to the rotating props is balanced out, but the full reaction due to the turning of the crank still acts on the cylinders. If, however, one prop is driven by means of gearing, the balancing-out of the torque-reaction may be carried back to the crankcase by way of the gear casing. In that event it either adds to or subtracts from the torque-reaction effect of the cylinders, according to the type of gearing used and the direction of the prop rotation.

Now for jet propulsion. These articles are good and you ought to publish them in book form, either now or when better times arrive. And, finally, I should like to compliment both the editorial staff and Mr. Geoffrey Smith.

F. UMPLEBY.

CORRESPONDENCE

CONTRA-PROP PITCH

Fluctuating Air Velocity

MAY I be permitted to try to amplify Mr. Cleaver's remarks (*Flight*, September 4th) for "Chemist"? The diagram drawn by the former was fundamentally wrong except for the case of an infinite number of blades. The air passing through an airscrew disc receives a periodic change of velocity at any given point in the disc. This velocity conforms to the velocity field around the aerofoil sections of the airscrew blades. Therefore, the induced velocity present at the rear set of blades of a contra-rotating airscrew is constantly varying at any given radius. The diagram given was only correct if a mean value of this velocity be accepted, or, as previously stated, if the blades be infinite in number.

This fluctuation of velocity is a possible source of vibration trouble with contra-rotating airscrews and was recognised as such by Mr. F. M. Thomas (then Airscrew Department Manager, de Havilland Co.) when he delivered a lecture to the Students' Section, R.Ae.S., in 1939. This fluctuation, and also the resultant induced velocity, depend upon the number of blades and the axial spacing of contra-rotating halves. Another point, unmentioned by Mr. Cleaver, was that the relative values of the axial and rotational induced velocities alter with blade angle, operating J and radial position for a given airscrew. At low J and torque coefficient, the axial velocity predominates, whereas, at high J, the axial and rotational velocities at .7R are approximately equal in magnitude. The relative setting of the contra-rotating halves could, in general, only achieve perfect torque balance at one given condition if the setting is fixed.

J. A. C. WILLIAMS.

CONTRA-ROTATING AIRSCREWS

Concerning Correspondence on Torque

WHAT a shoal of slippery mackerel and lurid herrings has responded to the sprat cast out by "Mystified"! Shade of Newton! How deep is the mystery now become!

It is a matter for sad reflection that among your correspondents, your "experts," your "labouring mountains," your "varlets of the slide rule who carry their want of learning in their phrases" (to misquote), recource be had to first principles only by two learned striplings of 16 and 17 years respectively (or are we to take comfort in the hope that there is a generation arising whose engineering practice will be more firmly founded than is that of many of our moderns?—those good, sound, practical men who "put into practice the errors of their forefathers" and measure the achievement of to-day with the yardstick of the past, thereby finding much for self-congratulation and smug satisfaction, rather than a spur to greater endeavour).

Have the heresies of Einstein destroyed the directness of thought as well as that of light? Does P still equal mf? or does torque still equal the rate of change of angular momentum? or is such thought altogether out-moded?

Was it such a one as these who declared that any schoolboy might learn Newton's laws of motion, but that it took the best part of a lifetime to learn how to apply them? And would three-score years and ten be enough in the case of some of these gentry?

But—I hear a conscience whisper, "There is a paper shortage!" Beshrew me! I am as bad as the worst of them, but having more shame, beg leave to subscribe myself,

PROPHET WITHOUT HONOUR.

Relative Speeds and Torque Values

YOUR correspondent, V. Marten-Gwilliam, raises a rather knotty problem with his letter in your October 9th issue, but is completely incorrect in assuming that the two propellers have equal torques, or, if the propellers are similar, rotate at equal speed. I reproduce his drawing in the next column.

If two shafts, geared together, have a speed ratio of N, then their torque ratio will be 1/N.

Now, assume that B is fixed. If A makes one revolution ↻, D makes

$$\frac{1}{1+\frac{B}{A}} \text{ revs. } \circlearrowleft$$

$$\therefore \frac{t_1}{T} = \frac{\text{revs. in A}}{\text{revs. in D}} = 1 + \frac{B}{A}$$

$$\therefore t_1 = T\left(1+\frac{B}{A}\right) \circlearrowright$$

Assume that D is fixed;

Then, if A makes one revolution ↻

B makes $\frac{A}{B}$ revs. ↺

$$\therefore t_2 = T\frac{B}{A} \circlearrowleft$$

Thus net torque on airscrews ↺

$$= t_1 - t_2$$

$$= T\left(1+\frac{B}{A}-\frac{B}{A}\right) = T \circlearrowright,$$

which is equal to torque on engine mountings.

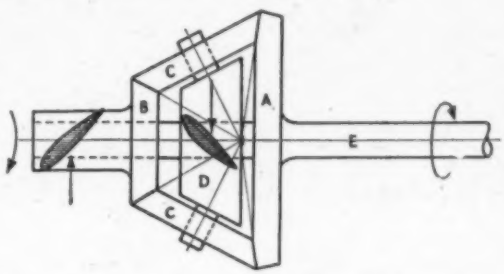
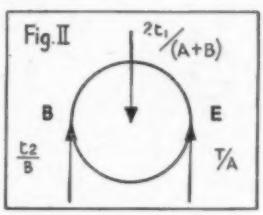


Fig. 1. A, B and C represent the *radii* of the respective gears.

Torque in E = T ↻
in D = t_1 ↺
in B = t_2 ↻

This may be proved in another manner. Fig. 2 shows a plan view of C.



Consider the forces acting on C due to torques in E, D and B.

Now Force = $\frac{\text{Torque}}{\text{Radius}}$

Then force due to E = T/A (upwards).

Force due to B = $\frac{t_2}{B}$ (upwards)

Force due to D = $\frac{2t_1}{A+B}$ (downwards)

Then for equilibrium :—

$$\frac{t_2}{B} = \frac{T}{A} \qquad \therefore t_2 = T\frac{B}{A} \circlearrowleft \text{ (i)}$$

and $$\frac{2t_1}{(A+B)} = \frac{t_2}{B} + \frac{T}{A} \quad \text{(ii)}$$

Substituting (i) in (ii) $\frac{2t_1}{(A+B)} = \frac{2T}{A}$

$$\therefore t_1 = T\left(1+\frac{B}{A}\right) \circlearrowright.$$

These are the results obtained above.

Thus, if radius of A were twice that of B, the propellers would adjust their revolutions so that D was absorbing three times the the torque of B.

It is difficult to see what advantages would be gained from this system; for maximum efficiency both propellers should rotate at equal speeds, so that the diameter of propeller at D would have to be $\sqrt[3]{3}$ that of propeller at B, as torque is proportional to diameter to the fourth power.

J. K. HAVILAND.

Further Aerial Differentiation

WHILST the fires of enthusiasm are still burning brightly over the contra-prop question and we are only waiting for the Rotol people to disclose precise details of their "appropriate gearing" for the matter to be finally settled, I wonder whether some of your readers would like to express their views about the following little problem.

In a letter to *Flight* of October 9th, I described a certain principle by which contra-rotation could be obtained from a single engine shaft (not two concentric shafts or a shaft and a sleeve) and stated, in effect, that if each propeller were capable of absorbing the same torque, this gear would automatically divide equally the torque applied to shaft *E* (see Fig. 1 in letter

CORRESPONDENCE

above) and that both propellers would rotate in opposite directions at equal speeds. Now I am not so sure. It seems that if D contributes $1 + \frac{B}{A}$ revs ↻ to A when B is stationary and if B contributes $\frac{B}{A}$ rev ↻ to A when D is stationary, then the mechanical advantage of A to B is $\frac{B}{A}$ and of A to D, $\frac{A + B}{A}$ i.e. 0.5 and 1.5 respectively if A = 2B, and that therefore the torque is not equally divided at equal speeds with aerodynamically equal propellers.

To secure equal torque distribution, therefore, it appears necessary to interpose a reduction gear between B and the forward propeller so that the latter has the same mechanical advantage as that of the propeller on D.

Since it is difficult to arrange a fixed point to take the reaction of this extra gear, the reduction must be effected epicyclically, using the reaction of an oppositely rotating sun pinion attached to the extremity of the engine shaft E. Owing to the relatively small differences in diameters of the gears required, this extra gear will also be of the bevel type as shown in Fig. 2.

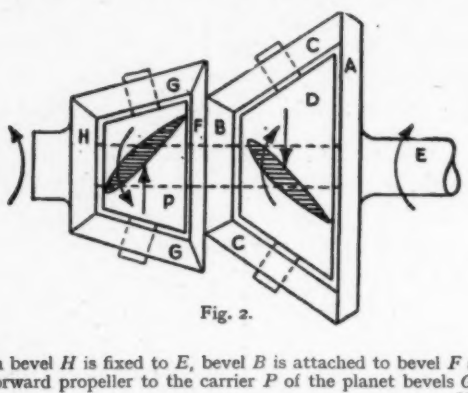


Fig. 2.

Sun bevel H is fixed to E, bevel B is attached to bevel F and the forward propeller to the carrier P of the planet bevels G.

If H is fixed and P makes one rev ↻, F makes $1 + \frac{H}{F}$ or $\frac{F + H}{F}$ revs ↻. Conversely if F makes one rev ↻, P, makes $\frac{F}{F + H}$ revs ↻.

Again, if F is fixed and P makes one rev ↺, then H makes $\frac{F + H}{H}$ revs ↺. Conversely, P makes $\frac{H}{F + H}$ revs ↺ if H makes one rev ↺.

Hence the total revs ↻ of P when F makes one rev ↻ and E and therefore H makes one rev ↺.

$$\frac{F}{F + H} - \frac{H}{F + H} = \frac{F - H}{F + H}$$

Now if the propeller on P is held stationary and E and H makes one rev ↺, F and B make $\frac{H}{F}$ revs ↻.

With B fixed and E and A making one rev ↺, propeller on D makes $\frac{A}{A + B}$ revs ↺.

But with A fixed and B making one rev ↻, D will make $\frac{B}{A + B}$ revs ↻.

Hence with P fixed, E, H and A making one rev ↺, D makes

$$\frac{A}{A + B} - \frac{H}{F} \times \frac{B}{A + B} = \frac{AF - BH}{F(A + B)} \text{ revs ↺}$$

relatively to a fixed point on the fuselage.

Now holding propeller on D stationary and turning E, H and A through one rev ↺, B and F will turn $\frac{A}{B}$ revs ↻ and P therefore turns through

$$\frac{F - H}{F + H} \times \frac{A}{B} \text{ revs ↻}$$

also relatively to a fixed point on the fuselage.

It therefore seems clear that if the mechanical advantages of each propeller are to be equal—

$$\frac{AF - BH}{F(A + B)} = \frac{A(F - H)}{B(F + H)} = R \text{ the desired reduction.}$$

Thus if R = half engine speed—

$$2A(F - H) = B(F + H)$$

and

$$\frac{B}{2A} = \frac{F - H}{F + H} \quad .. \quad .. \quad .. \quad .. \quad (1)$$

also, $2(AF - BH) = F(A + B)$

and

$$\frac{B}{A} = \frac{F}{F + 2H} \quad .. \quad .. \quad .. \quad .. \quad (2)$$

Combining (1) and (2) we have:

$$\frac{2(F - H)}{F + H} = \frac{F}{F + 2H}$$

whence $F^2 + FH - 4H^2 = 0.$

and $F = 1.5625\ H.$

Using this value of F in (1) or (2):

$A = 2.28\ B$ and from these proportions Fig. 2 has been drawn.

Putting the matter briefly, in non-technical language, propeller on B, in Fig. 1, is geared to go at twice engine speed but will turn more slowly because of the reduced mechanical advantage; whilst the propeller on D is geared to turn at two-thirds engine speed but will go more quickly on account of the increased mechanical advantage. The conundrum is—Will the arrangement of Fig. 1 divide the torque equally or will the added complication of Fig. 2 be necessary? I should much appreciate an expression of opinion on this point. Both schemes are drawn to give an overall reduction of half engine speed. In arriving at a conclusion one should not, of course, bring in the fact that with two geometrically similar propellers in close tandem the torques absorbed will be different at equal speeds owing to the twist in the slipstream, as this only complicates the issue. It is assumed that the propellers are aerodynamically similar when in position.

By the way, I have found that a useful dodge in checking over epicyclic gear layouts is to roll a shilling against a half-crown—of course, if one has the money! If not, it's really best to give up engineering altogether and enter Parliament!

V. MARTEN-GWILLIAM.

The Great "Contra-versy"

HAVING weighed up all the arguments advanced by correspondents and come to the conclusion that a contra-prop does definitely eliminate torque, I was rather shaken by Mr. Marten-Gwilliam's ingenious suggestion in *Flight* for October 9th. If his theories are correct his is unquestionably an example of a contra-prop arrangement which fails to provide a balanced power-unit. There is, however, a fallacy in his reasoning which I shall endeavour to explain in simple language.

Let us take the diameter of A as twice that of B, and consider what happens when A is turned through one revolution in the direction shown by the arrow.

The two airscrews will obviously "take the easiest way out" and do as little work as possible. In other words, they will, *between them*, push round as little air as possible.

Suppose the unit rotates *en bloc*, then each airscrew will make one revolution; total, two airscrew revs. Now assume, as does Mr. Marten-Gwilliam, that the airscrews rotate equally in opposite directions. Each airscrew turns through half a revolution; total, one airscrew rev. Admittedly the airscrews push less air round this way, but they do not push round the *least possible* amount of air. They achieve this result when the airscrew attached to gear B is stationary, for under these conditions airscrew B does no revolutions and airscrew D does two-thirds of a revolution; total, two-thirds of an airscrew revolution.

We see, therefore, that the system is not a contra-prop one at all—due to the fact that airscrew B remains stationary—but is merely a form of reduction gearing. It follows that the torque reaction is the same as for an ordinary single airscrew installation having the same reduction gear ratio.

The apparently unreasonable reluctance of airscrew B to rotate is explained by the omission of frictional forces from the argument.

The solution of this problem and the demonstration by many of your readers that gear-box torque-reaction supplies the equilibrating torque-reaction to that of the crankshaft surely establish that a contra-prop installation *does* eliminate torque between the power unit as a whole and the rest of the aircraft.

GEOFFREY D. EVERINGTON.

Service Aviation

Royal Air Force and Fleet Air Arm News and Announcements

THE KING has been graciously pleased to approve the following awards in recognition of gallantry and devotion to duty in the execution of air operations:—

The number after each name represents the squadron with which the recipient was serving at the time of the award.

DISTINGUISHED SERVICE ORDER.

Sqn. Ldr. P. R. BEARE, D.F.C., No. 104.
Act. Flt. Lt. E. R. ABBOTT, D.F.M., No. 50.

BAR TO THE DISTINGUISHED FLYING CROSS.

Act. Sqn. Ldr. G. A. C. POTTS, D.F.C., No. 50.
Sqn. Ldr. A. W. FLETCHER, D.F.C., R.A.F.O., No. 272.
Sqn. Ldr. A. C. RABAGLIATI, D.F.C., R.A.F.O., No. 46.
Sqn. Ldr. T. S. RIVETT-CARNAC, D.F.C., No. 37.
Act. Sqn. Ldr. R. A. BARTON, D.F.C., No. 249.

DISTINGUISHED FLYING CROSS.

Grp. Capt. V. B. BENNETT, No. 10.
Act. Wing Cdr. T. C. WEIR, R.A.F.O., No. 61.
Sqn. Ldr. J. D. HARRIS, No. 142.
Sqn. Ldr. E. J. LITTLE, No. 40.
Act. Flt. Lt. D. M. FOREMAN, R.A.F.V.R., No. 149.
F/O. P. R. CASEMENT, No. 61.
P/O. R. J. HANNAN, No. 49.
F/O. R. C. HIVAE, R.A.F.V.R., No. 35.
Act. F/O. P. S. JAMES, R.A.F.V.R., No. 35.
Act. F/O. G. MCRINER, R.A.F.V.R., No. 9.
P/O. J. CARTER, R.A.F.V.R., No. 53.
P/O. R. A. A. DOHERTY, R.A.F.V.R., No. 104.
P/O. S. J. EDWARDS, R.A.F.V.R., No. 102.
P/O. A. H. FOORD, R.A.F.V.R., No. 99.
P/O. F. H RAFFAELLI, R.A.F.V.R., No. 149.
P/O. I. A. ROBERTSON, R.A.F.V.R., No. 83.
P/O. H. E. WOOD, R.A.F.V.R., No. 51.
Wing Cdr. Paul Davie HOLDER.

BRISTOL INTERIOR: The pilot and observer in their Beaufighter. This sergeant pilot shadowed the German pocket battleship *Lutzow* up the Skaggerak for 6¼ hours.

Flt. Lt. Daniel Edward CREMIN.
Flt. Lt. William RILEY, No. 252.
F/O. James Cressy DAVIDSON, No. 252.
F/O. Donald Wilfrid STEVENTON.
F/O William TREGER, R.A.F.V.R., No. 148.
P/O. Alfred George Ernest DIXON, No. 55.
P/O. W. J. K. GLADWELL, R.A.F.V.R., No. 37.

DISTINGUISHED FLYING MEDAL.

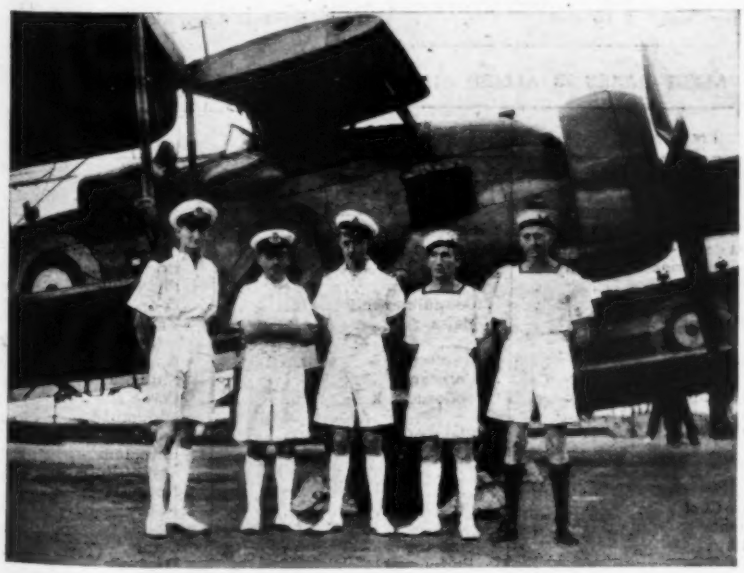
Flt. Sgt. Eric BALDWIN, No. 70.
Sgt. David BOWIE, No. 252.
Sgt. Ernest BUCKLEY, No. 252.
Sgt. Donald DIGGLES, No. 51.
Sgt. Clayton Edward HARGEST, No. 148.
Sgt. David Lloyd LEWIS, R.A.F.V.R., No. 59.
Sgt. Norman Trevor Hamilton WILSON, No. 98.
L.A.C. Edward Harry MARTIN.
A/C.2 Isaac Alexander TAYLOR.
Flt. Sgt. J. T. BEACH, No. 149.
Flt. Sgt. C. JONES, No. 40.
Flt. Sgt. H. F. ROCHFORD, R.N.Z.A.F., No. 214.
Flt. Sgt. P. SLEIGHT, R.A.F.V.R., No. 61.
Flt. Sgt. H. WATSON, No. 7.
Flt. Sgt. B. L. WILKINSON, No. 103.
Sgt. J. C. ADDY, R.A.F.V.R., No. 103.
Sgt. L. J. ALLUM, R.A.F.V.R., No. 51.
Sgt. R. N. AYLES, No. 103.
Sgt. B. P. BAKER, No. 142.
Sgt. J. E. BLAIR, No. 103.
Sgt. W. A. BUNN, R.A.F.V.R., No. 49.
Sgt. S. J. CONGDON, R.A.F.V.R., No. 104.
Sgt. J. H. COOX, No. 12.
Sgt. M. CORRIE, No. 104.
Sgt. W. C. DAVIES, No. 142.
Sgt. D. J. DRAKE, No. 144.
Sgt. H. H. DRUMMOND, No. 76.
Sgt. E. J. FORD, No. 9.
Sgt R. J. HEWETT, No. 9.
Sgt. E. M HUNTER, R.A.F.V.R., No. 50.
Sgt. J. LESLIE, A.A.F., No. 49.
Sgt. A. E. QUINTON, R.A.F.V.R., No. 50.
Sgt. F. SCOTT, No. 77.
Sgt. W. SWAIN, No. 102.
Sgt. W. TAYLOR, No. 21.
Sgt W. J TURNER, R.A.F.V.R., No. 405 (R.C.A.F.).
Sgt. L. J. WARE, No. 110.
Sgt. W. E. WATLING, No. 83.
Sgt. R. E. WHEATLEY, R.A.F.V.R., No. 77.

THE KING has been graciously pleased to approve the following awards:—

GEORGE MEDAL.

P/O. A. J. NICHOLSON, R.A.F.V.R.—In August, 1941, this officer was a passenger in an aircraft which was involved in a collision when taking off and crashed. The aircraft immediately caught fire, but P/O. Nicholson managed to get clear.

He remembered that when the plane crashed someone in the wireless compartment had been thrown across him. Ammunition and pyrotechnics were exploding and the whole front of the aircraft was in flames, but P/O. Nicholson, with complete disregard for his own safety, re-entered, and, making his way forward, found the wireless operator, whom he managed to drag to the door. An explosion then occurred which blew P/O. Nicholson a distance of 20 yards. The wireless operator was finally extricated by others, but, without doubt, his life was saved by P/O. Nicholson's gallantry in the first instance.



ARK ROYAL DECORATIONS: Recently Vice Admiral Sir James Somerville, K.C.B., D.S.O., visited H.M.S. Ark Royal to congratulate the ship's company for their work in the face of the enemy. Our photograph shows officers and ratings who were decorated for the part they played in the sinking of the *Bismarck*.

Roll of Honour

Air Ministry Casualty Communique No. 84.

THE Air Ministry regret to announce the following casualties on various dates. The next-of-kin have been informed.

Royal Air Force

KILLED IN ACTION (WHILE FLYING IN OPERATIONS AGAINST THE ENEMY).—Sgt. W. V. Atkinson; Sgt. O. H. Barlow; Sgt. A. E. Barrett; Act. Sqn. Ldr. R. Bickford, D.F.C.; P/O. J. C. Bosch; P/O. D. Bourne; Sgt. G. W. Duckmanton; Sgt. G. Fletcher; Sgt. L. E. S. F. Fouracre; Sgt. C. G. C. Frost; F/O. C. Grant; Act. Flt. Lt. J. S. T. Halliday; Sgt. B. Hemmings; Sgt. I. H. A. Henderson; Sgt. E. Horton; Sgt. K. Hutchinson; Sgt. D. H. Jones; Flt. Sgt. R. S. Knott; Sgt. A. E. Masters; P/O. J. Matthews; F/O. R. Munro; P/O. P. J. Murphy; Flt. Sgt. E. H. Nancarrow; Sgt. R. Naylor; Sgt. J. W. Nowlan; Sgt. J. A. Reynolds; P/O. R. J. Roake; Act. Sqn. Ldr. G. S. P. Rooney, D.F.C.; Sgt. J. Stevens; Sgt. S. C. Steward; Sgt. S. E. Traft; P/O. B. M. J. Vincent; Sgt. R. Wilkin; P/O. L. C. R. Wilson.

PREVIOUSLY REPORTED MISSING BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Sgt. F. L. Boham; Sgt. W. E. Burrell; P/O. J. Cutmore; P/O. R. M. A. Lakin; Sgt. S. C. McAdam; Sgt. N. R. Newey; Sgt. H. E.,

SERVICE AVIATION

Preston, D.F.M.; F/O. J. Robinson; Sgt. S. G. White; Sgt. C. S. Wynn.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—P/O. K. N. Arthurs; Sgt. H. W. J. Barr; Sgt. T. Beckett; Sgt. P. C. Benstead; Sgt. P. R. K. Burley; Sgt. F. L. Carter; Flt. Lt. L. P. Cattell; Sgt. G. Crowther; Sgt. D. B. Fleming; Act. Flt. Lt. C. D. Fox; Sgt. A. W. Gibson; P/O. R. C. Greenlees; Sgt. W. Haywood; F/O. I. S. Henderson; Sgt. T. W. James; Sgt. W. P. Jinks; Sgt. A. Livesey; Sgt. F. May; Sgt. R. B. Morris; Sgt. J. P. Redmond; P/O. J. H. Rowden; Sgt. L. E. Sawyer; Sgt. F. W. Smith, Sgt. J. Stewart; Sgt. R. P. Sweett; Sgt. H. A. E. Taylor; Sgt. R. E. Thompson; P/O. J. G. Toplis; F/O. P. F. Willing.

WOUNDED OR INJURED IN ACTION.—Sgt. F. A. Durnan; P/O. D. F. K. Edghill, D.F.C.; P/O. G. A. Hayhurst; Sgt. E. A. J. Hook; Sgt. R. S. J. Hubbard; Sgt. B. W. Johnson; Sgt. G. W. McC. Neill; Sgt. H. P. Reed; Flt. Sgt. W. H. Saville; Sgt. J. P. Shipton; Wing Cdr. D. R. Shore, A.F.C.; Flt. Sgt. T. W. Tait; Sgt. E. A. Windeor.

DIED OF WOUNDS OR INJURIES RECEIVED IN ACTION.—Sgt. A. S. Beningfield; Sgt. A. A. Jessup; Sgt. A. W. Snashall.

MISSING BELIEVED KILLED IN ACTION.—Sgt. W. F. Butler; Sgt. T. P. Butterfield; Sgt. M. H. Cope; Sgt. G. Crane; Sgt. I. I. Fiennes; Sgt. D. R. A. Garrick; Sgt. J. E. Jones; Sgt. E. H. Lager; Act. Flt. Lt. R. A. Lewis; Sgt. E. R. McAdam; Sgt. B. W. O'Hara; Sgt. L. D. Parry; Sgt. F. S. Payne; Sgt. R. S. Saunders; Sgt. D. D. Todd; Sgt. H. Tucker; Sgt. H. Vernon; Sgt. H. Wallace.

MISSING.—P/O. A. E. C. Adkins; Sgt. T. Appleby; Grp. Capt. J. F. T. Barrett, D.S.O., D.F.C.; F/O. C. C. Blair; Sgt. H. Brelsford; Sgt. H. J. E. Burrell; Sgt. W. H. Cole; Sgt. R. A. Copley; Sgt. D. Crosbie; Sgt. B. Davis; P/O. N. Dotchin; Flt. Sgt. E. E. Dowse; F/O. L. Duckworth; Sgt. J. D. Duthie; P/O. M. M. Evans; Sgt. W. Fisher; Sgt. J. W. Goddard; P/O. J. S. Harris; Flt. Lt. A. B. Harrison; F/O. M. J. C. Harwood, D.F.C.; Sgt. F. W. Hill; Sgt. C. Hodkinson; Sgt. W. Hutton; Sgt. V. F. Hyatt; Sgt. D. C. Hyslop; Sgt. W. Kay; Flt. Lt. R. B. Langlois, D.F.C.; Sgt. F. A. Leitch; Sgt. N. Lusher; Sgt. R. S. McKinnell; Sgt. J. W. McLarnon; Sgt. A. J. Manning; Sgt. J. L. Newton; Sgt. J. E. Nicholson; Flt. Sgt. W. A. Oastler; P/O. J. R. Parsons; P/O. C. J. Pearson; Sgt. A. H. Peek; P/O. T. P. Pratt; Sgt J. C. Proctor; Sgt. A. L. P. Rawlinson; Sgt. A. W. Rose; Sgt. F. C. Shea; P/O. G. V. Smith; Sgt. C. W. Strutt; Sgt. H. Thompson; P/O. H. C. Tonge; Sgt. L. C. Turner; Sgt. E. H. Tweed; Sgt. R. V. Urpeth; Wing Cdr. G. E. Valentine, D.S.O.; Sgt. S. H. Wakelin; F/O. R. H. Wheeler; Sgt. A. Williams; Sgt. R. M. William-; Sgt. A. C. Willis; Sgt. T. H. Willis; Sgt. F. W. York; Sgt. D. F. Youldon.

MISSING, BELIEVED KILLED ON ACTIVE SERVICE (WHILE ENGAGED ON NON-OPERATIONAL FLYING DUTIES OR ON THE GROUND THROUGH ENEMY ACTION).—Sgt. R. I. Berkin, L.A./C. F. C. Gleckler; A/C.1 D. A. McLeish; Sgt. C. L. Naylor; Sgt. D. R. Reader; Sgt. A. Thompson.

KILLED ON ACTIVE SERVICE.—Sqn. Ldr. W. B. Beale; P/O. G. H. Brown; Sgt. D. G. Creswell; L.A/C. H. G. Dicker; L.A/C. T. A. Dixon; Sgt. K. I. Gilbert; Sgt. D. W. Hall; Sgt. G. Hewison; Sgt. A. Jackets; Sgt. T. Kaye; L.A/C. R. S. Leggoe; P/O. G. J. Matthews; Sgt. H. G. Mole; Sgt. J. F. Moore; L.A/C. A. D. Moss; Sgt. F. P. Pilkington; P/O. A. W. Searle; L.A/C. H. Shannon; L.A/C. H. W. J. H. Vernon; Sgt. P. T. Vowles; A/C.1 K. M. Ward; P/O. J. W. Weir; L.A/C. W. G. Yeo.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED ON ACTIVE SERVICE.—L.A/C. A. H. Nicoll.

WOUNDED OR INJURED ON ACTIVE SERVICE.—L.A/C. H. W. Adams; Flt. Lt. A. G. Douglas; Sgt. A. G. Harbottle; P/O. E. H. Jacob; W/O. A. F. Jones; P/O. W. T. O'Regan.

DIED OF WOUNDS OR INJURIES RECEIVED ON ACTIVE SERVICE.—Act. Sgt. A. M. Dorey; A/C.1 W. F. Hunt.

PREVIOUSLY REPORTED WOUNDED OR INJURED ON ACTIVE SERVICE, NOW REPORTED DIED OF WOUNDS OR INJURIES RECEIVED ON ACTIVE SERVICE.—Sgt. J. T. Dunmore.

DIED ON ACTIVE SERVICE.—A/C.1 G. C. D. Bark; A/C.2 L. P. Hill; Cpl. W. Inkpen; Sgt. J. D. Johnston; Cpl. J. Leach; A/C.2 C. Ogden; L.A/C. L. S. H. Rayment; P/O. G. B. Rushton; F/O. A. A. F. T. Steavenson; A/C.1 W. R. Stevenson; Flt. Sgt. G. A. Whipps; L.A/C. A. W. Williams.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRISONER OF WAR.—Sgt. L. Pickford.

PREVIOUSLY REPORTED MISSING, NOW REPORTED PRISONER OF WAR.—Sgt. G. Kilburn.

FOR THE HIGHER UPS : The special equipments worn by the air crews of Boeing Fortresses on their stratospheric raids.

Royal Australian Air Force

DIED OF WOUNDS OR INJURIES RECEIVED IN ACTION.—P/O. D. L. Crichton.

MISSING, BELIEVED KILLED IN ACTION.—P/O. V. L. Dearman; Sgt. P. E. R. Fitzgerald; Sgt. D. L. J. Lawrence; P/O. G. L. Wells.

MISSING.—Sgt. H. L. Crump; P/O. D. J. Ritchie.

MISSING, BELIEVED KILLED ON ACTIVE SERVICE.—Sgt. R. L. Killen; P/O. K. T. Little.

EQUIVALENT RANKS IN ALLIED AIR FORCES

British	Free French	Polish	Czechoslovak
Marshal of the R.A.F.	Commandant en Chef des Forces Aériennes.	—	—
Air Chief Marshal	Général d'Arme Aérienne	—	—
Air Marshal	Général de Corps Aérienne	General Dywizji	Armadní Generál
Air Vice-Marshal	Général de Division Aérienne	General Brygady	Divisní Generál
Air Commodore	Général de Brigade Aérienne	—	Brigadní Generál
Group Captain	Colonel	Pulkownik	Plukovník
Wing Commander	Lieutenant-Colonel	Podpulknownik	Podplukovník
Squadron Leader	Commandant	Major	Major (Štábní Kapitán)
—	—	—	—
Flight Lieutenant	Capitaine	Kapitan	Kapitan
Flying Officer	Lieutenant	Porucznik	Nadporučík
Pilot Officer	Sous-Lieutenant	Podorucznik	Poručík
A/Pilot Officer	Sous-Lieutenant	—	Podporučík
Warrant Officer	Adjudant-Chef	Chorazy	Štábní Praporčík
			Praporčík
			Štábní Rotmistr
Flight Sergeant	Sergent-Chef Adjudant	St. Sierzant	Rotmistr Rotny
Sergeant	Sergent	Sierzant	Četar
Corporal	Caporal-Chef	Plutonowy	Desátník
Leading Aircraftman	Caporal	—	Svobodník
—	—	Kapral	—
Aircraftman 1st Class	Soldat 1ière Classe	St. Szeregowiec	Vojín
Aircraftman 2nd class	Soldat 2ième Classe	Szeregowiec	Vojín

Royal Canadian Air Force

KILLED IN ACTION.—Sgt. P. E. Carreau; P/O K. W. Liebeck; Sgt. L. C. Mansell; Sgt. W. T. R. Stephenson.

MISSING, BELIEVED KILLED IN ACTION.—P/O W. A. Casey; Sgt. N. L. Johnston; Sgt. V. Y. H. Sewell.

MISSING.—Sgt. A. N. Blackmore; P/O. C. K. Bowen; P/O. J. P. Erly; Sgt. J. R. Gordon; Sgt. S. Harcus.

KILLED ON ACTIVE SERVICE.—Sgt. J. F. P. Stuart; Sgt. M. C. Tagseth.

DIED ON ACTIVE SERVICE.—L.A/C. J. S. Watson.

Royal New Zealand Air Force

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Sgt. C. E. Donehue.

MISSING.—Sgt. W. D. Hamer; P/O. A. F. Mc Gruer; P/O. K. S. Peterson, D.F.C.; Sgt. R. P. Porteous.

KILLED ON ACTIVE SERVICE.—P/O. D. G. Doole

DIED ON ACTIVE SERVICE.—Sgt. I. L. Jones.

Casualty Communique No. 87.

Royal Air Force

KILLED IN ACTION (WHILE FLYING IN OPERATIONS AGAINST THE ENEMY).—Sgt. T. H. B. Corrie; Sgt. F. Wrigley.

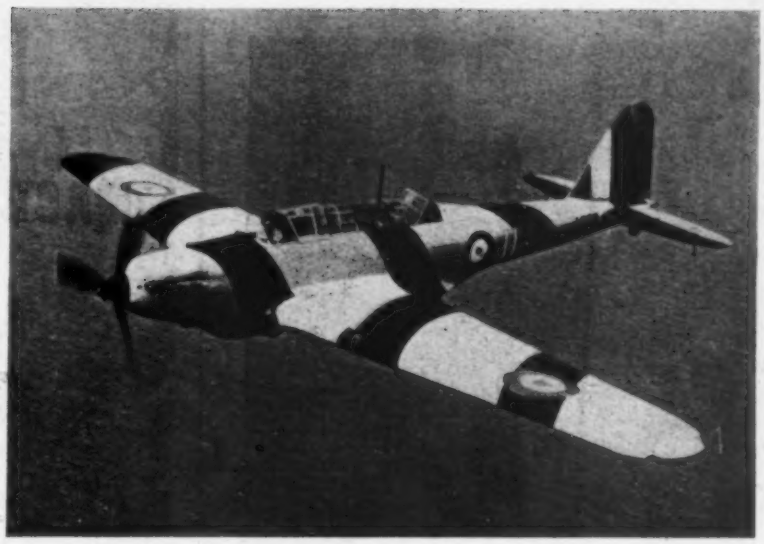
PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Sgt. F. Ashurst; P/O. C. McC. Bateman; Sgt. P. H. Beckett; Sgt. J. S. Bools; P/O. W. L. Boon; Sgt. K. S. Campbell; P/O. J. G. Curley; Sgt. D. C. K. Dunne; Sgt. A. G. Elder; Sgt. D. Fletcher; Sgt. J. M. Fulford; P/O. L. T. Glover; Sgt. L. F. Harris; Sgt. J. L. Hart; P/O. E. T. Laverack; Sgt. W. F. McKay; Sgt. W. A. Millar; P/O. A. A. Morgan; A/C.1 G. Morris; Sgt. J. B. Murray; Sgt. E. I. Pocock; Sgt. G. G. Prescott; Sgt. P. V. Read; Flt. Lt. F. H. Savage; Flt. Lt. J. F. Sharp; Sgt. R. Smith; F/O. F. J. Swain; Sgt. H. C. Tuckwell; F/O. K. G. Webb; Sgt. N. S. Weir; Sgt. F. Woodruff; Sgt. J. Woodward.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Sgt. V. L. Bagley; Sgt. J. F. R. Boyall; Sgt. W. J. Butler; Sgt. J. E. Caddick; Sgt. S. R. Cassey; Sgt. M. P. Cazalet; Sgt. H. Cowling; Sgt. B. L. T. Crawforth; Sgt. G. C. Daniel; P/O. D. W. Date; Sgt. D. Day; Sgt. J. Dunning; Sgt. S. Felman; Sgt. L. R. Hawley; Sgt. N. F. Jackson; Act. Flt. Lt. T. N. Linley; Sgt. G. Lynch; P/O. E. P. Moore; Sgt. N. A. Morant; Sgt. F. G. Prettyman; Sgt. N. V. Pusey; Sgt. J. Ratcliffe; Sgt. K. J. Ridgewell; Sgt. C. D. Robertson; Sgt. C. B. Rogers; Sgt. R. A. Royal; Sgt. R. V. Salway; Sgt. D. Skene; Sgt. S. Terry; Sgt. J. Thompson; Sgt. J. L. Tomkinson; Sgt. C. G. H. Ward; Sgt. B. J. O. Watkins; Sgt. E. White; P/O C. G. L. Williams, D.F.M.

PREVIOUSLY REPORTED MISSING, NOW REPORTED KILLED IN ACTION.—Sgt. T. E. Gledhill; Sgt. J. S. C. Sherman; Sgt. G. T. Shirley.

WOUNDED OR INJURED IN ACTION.—P/O. B. S. Booker; Sgt. L. E. Burgess; Sgt. J. M. Foster; Sgt. H. L. Sanderson; Sgt. J. C. Stacey.

Air Commodore M. B. Frew, D.S.O., M.C., D.F.C., Chief of the Air Mission and Air Officer Commanding Air Training in South Africa.



BATTLE STRIPES : A training Fairey Battle, in waspish suit of black and yellow on bombing practice over Lake Erie.

DIED OF WOUNDS OR INJURIES RECEIVED IN ACTION.—Sgt. F. E. Gunther; Sgt. W. E. Van-Klaveren.

MISSING, BELIEVED KILLED IN ACTION.—Sgt. R. C. Baumber; St. J. W. T. Davies; Sqn. Ldr. P. F. Edinger; Sgt. D. W. Gillies; Sgt. R. G. Hill; Sgt. R. J. Hollobone; Sgt. D. G. Kemp; Sgt. M. Koransky; Sgt. D. W. Mercer; Sgt. W. E. Stayte; Sgt. A. F. Suckling; P/O. E. M. Watts; Sqn. Ldr. E. P. Willcox, D.F.C.; Sgt. F. Woodcock; Sgt. J. K. Young.

MISSING.—Sgt. W. J. Barker; P/O. H. Batzofin; Sgt. W. Bearne; Sgt. R. H. Beattie; Sgt. T. C. Boyle; Sgt. W. C. E. Broomhead; Sgt. J. Brown; Sgt. N. C. J. Carter; Sgt. E. K. Cartledge; Sgt. L. T. Chapman; Act. Sqn. Ldr. F. R. H. Charney, D.F.C.; Sgt. J. M. Christie; Sgt. W. N. Collins; Sgt. P. B. Corbett; Sgt. P. Cowan; Act. Wing Cdr. G. L. Cruickshanks; Sgt. R. Davies; Act. Sqn. Ldr. W. Davies; Sgt. E. Dyer; F/O. W. Esplen; Act. Flt. Lt. K. J. Falconer, D.F.C.; Sgt. J. Fuller; P/O. T. M. Gay; Sgt. A. H. Graham; Sgt. D. R. Harris; P/O. F. G. Hart; Sgt. S. A. Harvey; Sgt. R. K. Hayes; Sgt. A. A. S. Heggie; Sgt. R. B. D. Hill; Sgt. W. G. Honey; F/O. A. G. Inderwick; P/O. J. E. Johnson; Sgt. R. H. Kenvin; Sgt. G. Law; Flt. Sgt. J. W. Lucas; P/O. J. McGregor-Cheers; Sgt. T. P. Machale; P/O. V. M. Markham; Sgt. C. V. Matheson; Sgt. R. M. Minchin; Sgt. K. McI. Newton; Sgt. A. N. Page; Sgt. H. A. Perks; Flt. Sgt. J. E. Phillips; Sgt. S. Porteous; Sgt. P. Y. Reilly; F/O. D. A. A. Romans, D.F.C.; Sgt. J. H. Smythe; Sgt. C. J. Storer; Sgt. R. L. Thomas; P/O. F. B. Thorpe; Sgt. P. M. Wakefield; Act. Wing Cdr. R. D. Welland; Sgt. D. G. Willis; P/O. J. Wood; Sgt. D. J. Wyatt.

MISSING, BELIEVED KILLED ON ACTIVE SERVICE (WHILE ENGAGED ON NON-OPERATIONAL FLYING DUTIES OR ON THE GROUND THROUGH ENEMY ACTION).—A/C.2 H. Whitaker.

KILLED ON ACTIVE SERVICE.—Flt. Sgt. J. E. Bignell; A/C.2 C. F. Chapman; L.A/C. D. T. Clark; L.A/C. S. D. Duff; A/C.2 D. Flint; Sgt. E. E. Frisby; Act. Flt. Lt. H. B. Gilchrist; Sgt. R. H. Gratton-Doyle; Flt. Sgt. F. Greaney; Sgt. N. McL. Gregor; P/O. T. Haig; L.A/C. J. R. Harrison; L.A/C. R. Howard; F/O. D. M. Lake; Cpl. F. T. Palmer; Sgt. J. B. Payton; Sgt. D. G. W. Selby-Lowndes; Sgt. J. R. Wallace; Sgt. F. R. Westcott; Sgt D. L. Willacy.

PREVIOUSLY REPORTED KILLED IN ACTION, NOW REPORTED KILLED ON ACTIVE SERVICE.—Sgt. P. W. Bryant.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED ON ACTIVE SERVICE, NOW PRESUMED KILLED ON ACTIVE SERVICE.—Sgt. D. F. Cade; L.A/C. J. T. Catt; Sgt. T. V. Davies; Sgt. C. J. Dixon; Sgt. D. C. Haynes; Sgt. W. Jones; Sgt. W. B. Oakes; A/C.2 D. S. Owens; A/C.2 J. L. F. Stedman.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED ON ACTIVE SERVICE, NOW REPORTED KILLED ON ACTIVE SERVICE.—Sgt. K. Garrett; Sgt. R. A. Hopkins; L.A/C. W. L. Morris; F/O. A. K. Round.

PREVIOUSLY REPORTED MISSING, NOW REPORTED KILLED ON ACTIVE SERVICE.—Act. Wing Cdr. A. G. Weir.

WOUNDED OR INJURED ON ACTIVE SERVICE.—Act. Sqn. Ldr. D. E. Bennett; L.A/C. B. C. Forsdick; Sgt. H. Henley; P/O. D. M. Keys; P/O. C. M. Maynard; Cpl. W. N. Newcombe; Sgt. R. Whitlock.

DIED OF WOUNDS OR INJURIES RECEIVED ON ACTIVE SERVICE.—A.A/C. T. Audsley.

DIED ON ACTIVE SERVICE.—A/C.1 S. R. Baker; A/C.1 N. I. Downing; L.A/C. N. S. Ellis; P/O. G. F. Harmsworth; A/C.2 H. Maxwell; A/C.1 G. S. Norman; A/C.2 A. Pacitto; A/C.2 E. Potts; Flt. Sgt. K. C. Rendel; L.A/C. R. W. Scott; L.A/C. D. H. M. Wilson.

PREVIOUSLY REPORTED MISSING, NOW REPORTED PRISONER OF WAR.—Sgt. L. R. Biddlecombe; Sgt. A. R. Carvell; Sgt. B. Davis; P/O. J. W. W. Graham; Sgt. W. D. Hughes; Sgt. E. H. Tweed; Flt. Sgt. W. Wetherill.

AMENDMENT TO PRESS COMMUNIQUE NO. 85.

Under the heading PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION for Carter, Act. Flt. Lt., M.M., read Carter, Act. Flt. Lt., M.M., D.F.C.

Royal Australian Air Force

DIED OF WOUNDS OR INJURIES RECEIVED IN ACTION.—Sgt. V. V. Skerman.

MISSING.—P/O. J. Dodds; Sgt. D. V. Logan.

KILLED ON ACTIVE SERVICE.—Sgt. J. N. Hanigan; Sgt. A. D. C. La Gruta; Sgt. K. V. Williams.

PREVIOUSLY REPORTED MISSING, NOW REPORTED PRISONER OF WAR.—Sgt. H. L. Crump.

Royal Canadian Air Force

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Sgt. W. W. Heywood.

MISSING, BELIEVED KILLED IN ACTION.—Sgt. D. M. Hughes; Sgt. J. H. Painter.

MISSING.—P/O. E. G. M. Anderson; Sgt. J. B. Anderson; Sgt. D. W. Bennett; Sgt. I. P. Graham; Sgt. M. S. Humphrey; Sgt. H. Merrill; Sgt. H. A. Taylor; Sgt. T. H. Wood.

KILLED ON ACTIVE SERVICE.—F/O. H. J. Findlay; Flt. Lt. W. Richards; Sgt. E. K. Vickers.

PREVIOUSLY REPORTED KILLED IN ACTION, NOW REPORTED KILLED ON ACTIVE SERVICE.—Sgt. W. Stuart.

WOUNDED OR INJURED ON ACTIVE SERVICE.—Sgt. E. W. Smith.

PREVIOUSLY REPORTED MISSING, NOW REPORTED PRISONER OF WAR.—Sgt. A. N. Blackmore; Sgt. J. R. Gordon; Sgt. S. Harcus.

Royal New Zealand Air Force

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Sgt. F. S. Haslemore.

MISSING, BELIEVED KILLED IN ACTION.—P/O. R. J. Minnis.

MISSING.—Sgt. G. Carman.

PREVIOUSLY REPORTED KILLED IN ACTION, NOW REPORTED KILLED ON ACTIVE SERVICE.—P/O R. S. Austin.

South African Air Force

KILLED IN ACTION.—Capt. D. D. Pannell.

MISSING.—Air Sgt. D. J. McIntosh; Air Sgt. J. D. Tonkin.

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